LAKESIDE FIRE STATION

STP 09-014
ER 98-10-014

ACOUSTICAL SITE ASSESSMENT REPORT

MPA 09-030

Updated October 2, 2009

July 15, 2009

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Acoustical Site Assessment Report

Lakeside Fire Station
12224 Lakeside Avenue
Lakeside, CA 92040

County of San Diego Case Numbers: MPA 09-030

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October 2, 2009
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GLOSSARY OF TERMS AND ACRONYMS

A-Weighted Sound Levels	Decibels (referenced to 20 micro-Pascals) as measured with an A-weighting network of standard sound level meter, abbreviated dB(A)
ADT	Average daily trips
ANSI	American National Standards Institute
Background Noise	The measured ambient noise level associated with all existing environmental, transportation, and community noise sources, in the absence of any audible construction activity
Cadna	Computer Aided Noise Abatement
Caltrans	California Department of Transportation
CEQA	California Environmental Quality Act
CNEL	Community Noise Equivalent Level: A 24-hour average, where sound levels during the evening hours of 7:00 p.m. to 10:00 p.m. have an added 5 dB weighting, and sound levels during the nighttime hours of 10:00 p.m. to 7 a.m. have an added 10 dB weighting; this is similar to and often used interchangeably with L_{DN}
Construction Site	For purposes of noise and vibration control requirements, the contract limits of construction; this includes right-of-way lines, property lines, construction easement boundary or property lines, and contractor staging areas outside the defined boundary lines, used expressly for construction
DNL or L_{DN}	Day-Night Sound Level - A 24-hour average, where sound levels during the nighttime hours of 10:00 p.m. to 7:00 a.m. have an added 10 dB weighting, but no added weighting on the evening hours, abbreviated as DNL or L_{DN}
dB	Decibel
dB re	dB reference to
dBA	A-weighted sound pressure level
Daytime	The period from 7:00 a.m. to 10 p.m.
Evening	The period from 7:00 p.m. to 10:00 p.m.
Ft	Feet

HNL	Hourly noise level
HVAC	Heating, ventilating, and air conditioning
I-8	Interstate 8
L_{EQ}	The equivalent sound level, or the continuous sound level, that represents the same sound energy as the varying sound levels, over a specified monitoring period
$L_{EQ}(h)$	One-Hour Equivalent Noise Level
L_{MAX}	The root-mean-square (rms) value of the period measurement peak noise level
mph	Miles per hour
Nighttime	Periods other than daytime (as defined above), including legal holidays
Noise	Any audible sound that has the potential to annoy or disturb humans, or to cause an adverse psychological or physiological effect in humans
Noise Level Measurements	Unless otherwise indicated, the use of A-weighted and "slow" response of instrument complying with at least Type 2 requirements of latest revision of American National Standard Institute (ANSI) S1.4. Specification for Sound Level Meters
Noise-sensitive Location	A location where particular sensitivities to noise exist, such as residential areas, institutions, hospitals, parks, or other environmentally sensitive areas
NSLU	Noise Sensitive Land Use
Octave-Filtered and Octave-Filtered Data	A contiguous series of continuous sound spectra centered about the stated frequency with half of the bandwidth above and half below the stated frequency; this data is used for machinery noise analysis and barrier effectiveness calculations
rms	Root mean square
ROW	Right-of-way
sec	Second

Sound Transmission Class (STC)	A single number rating calculated in accordance with ASTM E413, using values of sound transmission loss; it provides an estimate of the performance of a partition in certain common sound insulation problems
SPL	The 1-second (slow) A-weighted noise level,
TNM	Traffic Noise Model
VdB	Vibration velocity level in decibels
Vibration	Velocity in microinches per second; vibration levels are expressed as velocity levels in decibels referenced to one microinch per second, abbreviated VdB

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EXECUTIVE SUMMARY

This acoustical analysis report is submitted to satisfy the acoustical requirements of the County of San Diego for a site and building plans. Its purpose is to assess noise impacts to and from the proposed project.

The proposed project consists of the construction and operation of a fire station. Construction would include rough grading, foundation excavation, foundation pour, utilities excavation, building construction, finish grading, and paving. The fire station would include on-site living quarters and administrative office space for the district fire operations within one structure. Other smaller structures located to the east of the proposed fire station structure include a trash area, training area, and fuel storage and generator area. HVAC units are also included. Parking, driveways, private road improvements, and an open area for future use are also proposed.

The site is located in a semi-rural area on the north side of the intersection of Lakeside Avenue and Channel Road ("Y" intersection), in the unincorporated community of Lakeside, County of San Diego, California. Residences exist to the east, west and north. A concrete batch plant operation exists to the southwest of the project site and a paved lot that stores large trucks exists to the southeast. The project site is partially developed with a small section of old roadway and a single residence.

Existing noise sensitive land uses (NSLUs) includes the surrounding residences. Proposed onsite NSLUs include habitable space and offices located within the proposed structure.

The main noise source in the area is vehicular traffic along Lakeside Avenue and Channel Road. Other surrounding uses generate a negligible amount of noise. The measured noise level for the site was 69.5 dBA L_{EQ}.

The proposed project would introduce additional construction, traffic and equipment that has the potential to impact on- and off-site NSLUs. Construction would follow the County's guidelines and would result in less than significant noise impacts. Considering that the project would increase traffic by 50 average daily trips, the proposed project would generate a negligible contribution (0.2 dBA) to the future off-site traffic noise level. On-site driveway and parking traffic is also considered negligible. Proposed on-site non-transportation noise sources include building heating, ventilating, and air conditioning (HVAC) systems and an emergency back-up generator. It is noted that the County exempts emergency back-up generators and emergency sirens from the County noise limits. The HVAC units have been properly designed to avoid significant noise impacts. Impacts from the proposed project to on- and off-site uses would therefore be less than significant.

The County guidelines require interior noise levels to below 45 CNEL in habitable/residential space and 50 dBA in office space. Assuming a 15 dBA or CNEL standard reduction in exterior to interior noise, the proposed habitable space would need to be located outside the 60 dBA/CNEL exterior noise contour and the proposed offices would need to be located outside the 65 dBA/CNEL exterior noise contour. All receiver locations are located in an area that exceeds 60 CNEL in the peak hour and receivers 6 to 20 are in an area that exceeds 65 CNEL, and this potentially significant traffic noise impacts could occur to the proposed NSLUs. With the inclusion of improved residential door sealing, 28 STC windows specifications, and the proper ventilation system to allow windows to be kept closed, these impacts would be reduced to less than significant.

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1.0 INTRODUCTION

This acoustical analysis report is submitted to satisfy the acoustical requirements of the County of San Diego (County) for a proposed Fire Station. Its purpose is to assess noise impacts from nearby roadway traffic and to identify project features or requirements necessary to maintain project office space and interior living space noise levels consistent with County policies and ordinances. This report will also determine the noise impact of the operation of proposed mechanical equipment used for backup power generation, kitchen ventilation, heating, ventilating, and air conditioning to the properties adjacent to the project site. Finally, temporary construction noise is considered to determine if construction-noise mitigation is necessary.

1.1 Project Description

The proposed project consists of the new construction of new fire station located north of the Channel Road and Lakeside Avenue intersection in Lakeside, San Diego County, California (Figure 1 and 2). The fire station would include on-site living quarters and administrative office space for the district fire operations within one structure located directly north of the Channel Road and Lakeside Avenue intersection (Figure 3). Other smaller structures located to the east of the proposed fire station structure include a trash area, training area, and fuel storage and generator area. HVAC units would be included on the roof of the proposed structure. A parking lot would be provided to the north of the fire station structure that would include a secured parking area. A 9,936 square-foot open area to the north of the parking lot would be preserved for future uses. Paved emergency vehicular access to the fire station would be provided through the fire station to both Channel Road and to Lakeside Avenue. The project also includes relocating and paving the existing private road along the western and northern site boundary. Access to the residence to the east would continue to be provided by this private road. Project-related grading would lower the maximum elevation of the project site and include the development of a retaining wall as part of the main building on the north side.

The architectural building plan specifications for the typical exterior wall assembly in the living quarters and office areas incorporated into this acoustical analysis are:

- Single layer of 7/8-inch thick stucco
- 2-inch wide by 6-inch deep wood studs, placed 16-inches on-center
- Single layer of 3 1/2-inch thick faced fiberglass batt insulation
- Double layer of 5/8-inch thick Type X gypsum board

INSUL evaluation of the exterior wall proposed for this project resulted in an approximate STC rating of 46, which was incorporated into this analysis.

The proposed project construction activities can be roughly divided into seven phases. These phases may contain some overlap dependent on location and timing. The phases would include the following:

1. Rough grading: This phase typically consists of the use of heavy equipment, potentially including large dozers, excavators, scrapers, compactor, water truck, and a variety of smaller equipment to create the basic building, road, and outdoor elevations desired.
2. Foundation excavation: This phase typically involves the use of medium-sized equipment, which may include a small dozer, backhoe or excavator, compactor, water truck, and a variety of smaller equipment to create the finished pad elevation and foundation excavation.
3. Foundation pour: The individual building pads are created by having concrete delivered from an off-site mixing facility and pumping it with a reed boom truck throughout the foundation area to create a finished building pad.
4. Utilities excavation: This phase would include the use of an excavator or backhoe and a trencher throughout the site to allow for underground utilities.
5. Building construction: The building framing and exterior is constructed manually with the use of forklifts and light mobile cranes.
6. Finish grading: Typically a grader, water truck, compactor and sometimes a small dozer and/or skidsteer, are used to prepare the site for paving and landscaping.
7. Paving: Concrete or blacktop is delivered to the site from an off-site mixing facility, spread over the planned hard surface areas and is then either compacted or allowed to cure.

1.2 Environmental Setting and Location

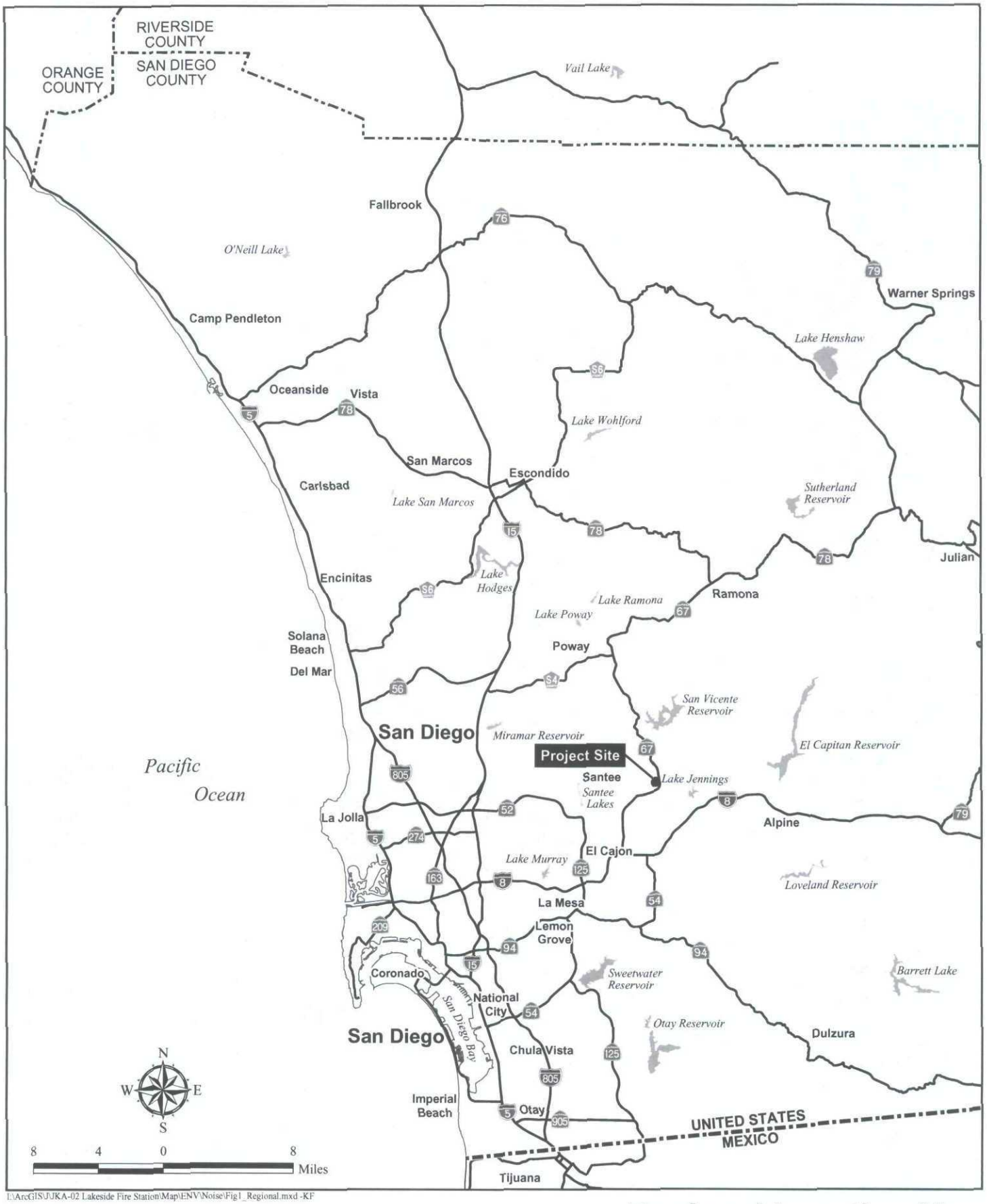
a. Setting and Location

The site is located in a semi-rural area on the north side of the intersection of Lakeside Avenue and Channel Road ("Y" intersection). The project site is located on the north of the Lakeside Avenue and Channel Road intersection in the unincorporated community of Lakeside, County of San Diego, California (Figure 1). The Assessor's parcel number's (APNs) for the property are 319-130-3400, 392-090-18, 379-210-2200, 379-210-2400, and 379-210-2500 (Figure 2). The geographic location is 32° 51' 59.16" N, 116° 55' 41.35" W.

The project site is partially developed with a small section of old roadway and a single residence. The site is approximately 170 feet above sea level (amsl) in the northern area and 110 feet amsl in the southern area (Figure 3). The Project site slopes upward towards the northeast away from Lakeside Avenue.

Land use in the general area is a scattered mix of residential, business, and light industrial uses. The residential uses to the east, west, and north are large-lots, rural, single-family homes. A concrete batch plant operation exists to the southwest of the project site and a paved lot that stores large trucks exists to the southeast. Lakeside Avenue is a two-lane roadway that extends from Channel Road eastward. Channel Road is a two-lane roadway north of Lakeside Avenue and a four-lane roadways south of Lakeside Avenue.

Current County General Plan land use designations for the project site are residential (4.3 dwelling unit per acre and 1 dwelling unit per one/two/four acre[s]). Surrounding land use designations to the north of Channel Road and Lakeside Avenue are residential (4.3 dwelling



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Regional Location Map

LAKESIDE FIRE STATION NO. 2

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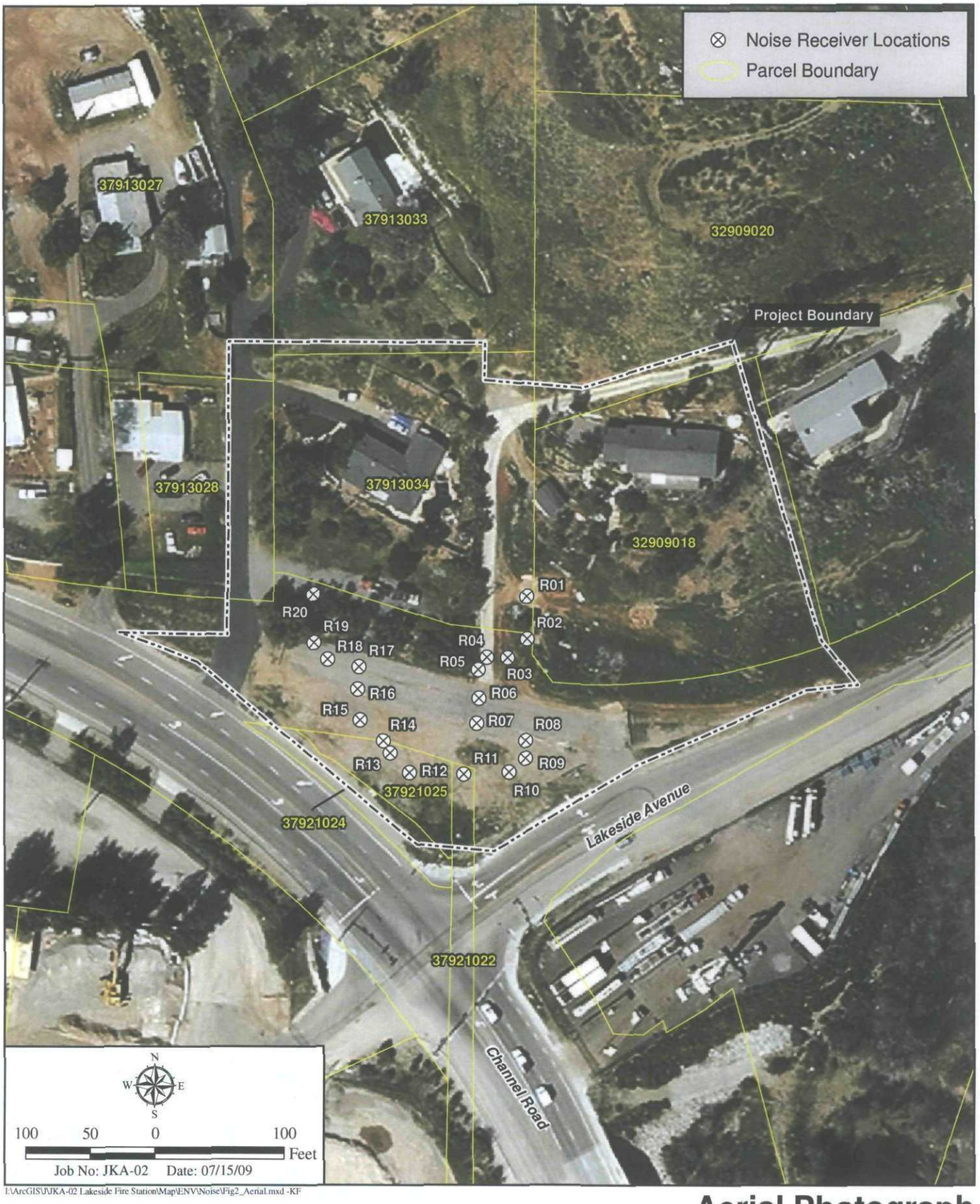
Figure 1



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Aerial Photograph

LAKESIDE FIRE STATION NO. 2

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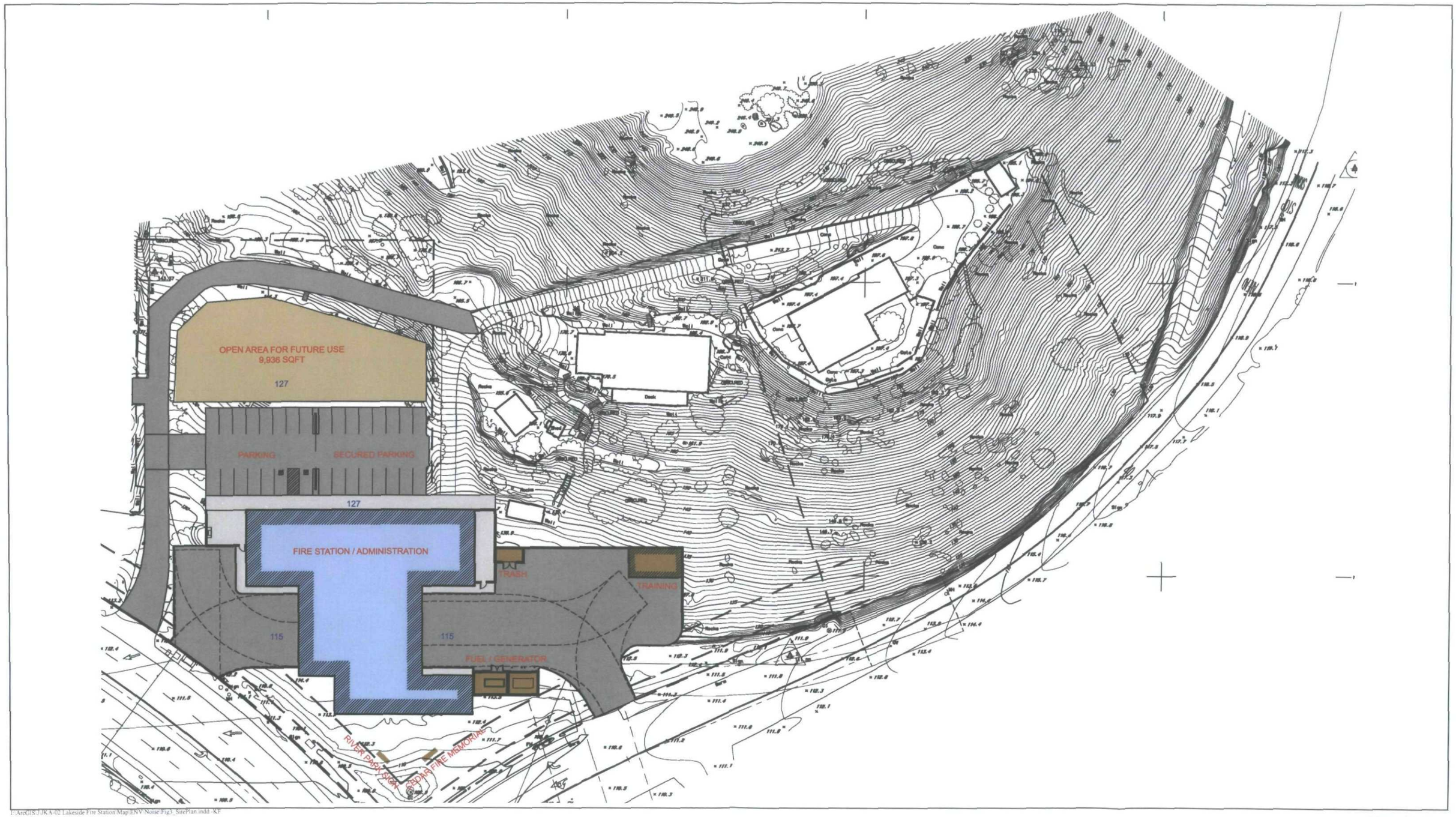
Figure 2



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Site Plan

LAKESIDE FIRE STATION NO. 2

Figure 3

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unit per acre and 1 dwelling unit per one/two/four acre[s]), and surrounding land uses to the south of Channel Road and Lakeside Avenue are Specific Plan Area. The site is zoned as Limited Agriculture (A-70), Single-family Residential (RS-4), and Specific Plan (S-88). The areas to the north and east of the site are zoned A-70, the area to the west is designated RS-4 and S-88, and the area to the south of the project is designated as S-88.

b. Existing Noise Conditions

The primary noise source in the vicinity of the project site is generated by automobile and truck traffic using Lakeside Avenue and Channel Road to the south of the project. The posted speed limit for both Lakeside Avenue and Channel Road is 45 miles per hour (mph). Traffic data used in the site planning was obtained from the San Diego Association of Governments Department of Transportation (SANDAG) website (Appendix B). Because the project site is at the "Y" intersection of Lakeside Avenue and Channel Road, roadway traffic volumes are different for Lakeside Avenue southeast of the project site and southwest of the project site. Refer to Table 1 for the most recent traffic volume data available (Year 2003).

Table 1
EXISTING TRAFFIC CONDITIONS

Street/ Segment	2003 ADT
Channel Road	15,000
West Lakeside Avenue	14,000
East Lakeside Avenue	4,000

Source: SANDAG 2009
Notes:
ADT= Average Daily Traffic Volume.

The industrial land use to the southwest (e.g., batch plant) of the site creates low levels of background noise during the daytime but the noise generated is not considered significant because of the intermittent nature and distance. Noise generated from the vehicle storage lot to the southeast is not considered significant due to the intermittent nature of noise generation from vehicles. The nearest airport is Gillespie Field located 3.5 miles to the southwest and is not anticipated to generate a significant amount of noise in the vicinity of the project site due to the distance. The existing on-site residence and surrounding residential uses are not considered significant noise generators. No construction activity exists in the immediate vicinity of the site.

1.3 Methodology and Equipment

a. Noise Measuring Methodology and Procedures

Typically, a "one-hour" equivalent sound level measurement (L_{EQ}, A-Weighted) is recorded for at least one noise-sensitive location on the site. During the on-site noise measurement, start and end times are recorded and vehicle counts are made for cars, medium trucks (double-tires/two

space. Likewise, any building located completely outside the 65 dBA/CNEL contour is assumed to be in compliance with a maximum interior noise level of 50 dBA/CNEL for office space. All receiver locations are located in an area that exceeds 60 CNEL in the peak hour and receivers 6 to 20 are in an area that exceeds 65 CNEL. Therefore, proposed project building structures exposed to exterior noise levels greater than 60 CNEL could be subject to interior noise levels exceeding the 45 CNEL noise limit for residential habitable space and 50 dBA for the office space. These impacts could be mitigated by enhanced building construction techniques, as discussed in Section 2.3 below. Traffic noise impacts to on-site NSLUs would therefore be significant and mitigable.

On-site Transportation Noise

The propose project would include a parking lot with a short driveway. Parking lot noise would create negligible vehicular noise. Normal parking lot vehicle noise would be negligible at NSLUs. It should be noted that the fire station emergency activities are not considered since they are exempt. Thus, no on-site transportation noise impact would result from the proposed project.

Off-site Non-transportation Noise

No off-site noise sources have been identified in the area that would provide significant noise impacts to NSLUs in excess of allowable limits. Thus, no off-site non-transportation noise impact would result from the proposed project.

On-site Non-transportation Noise

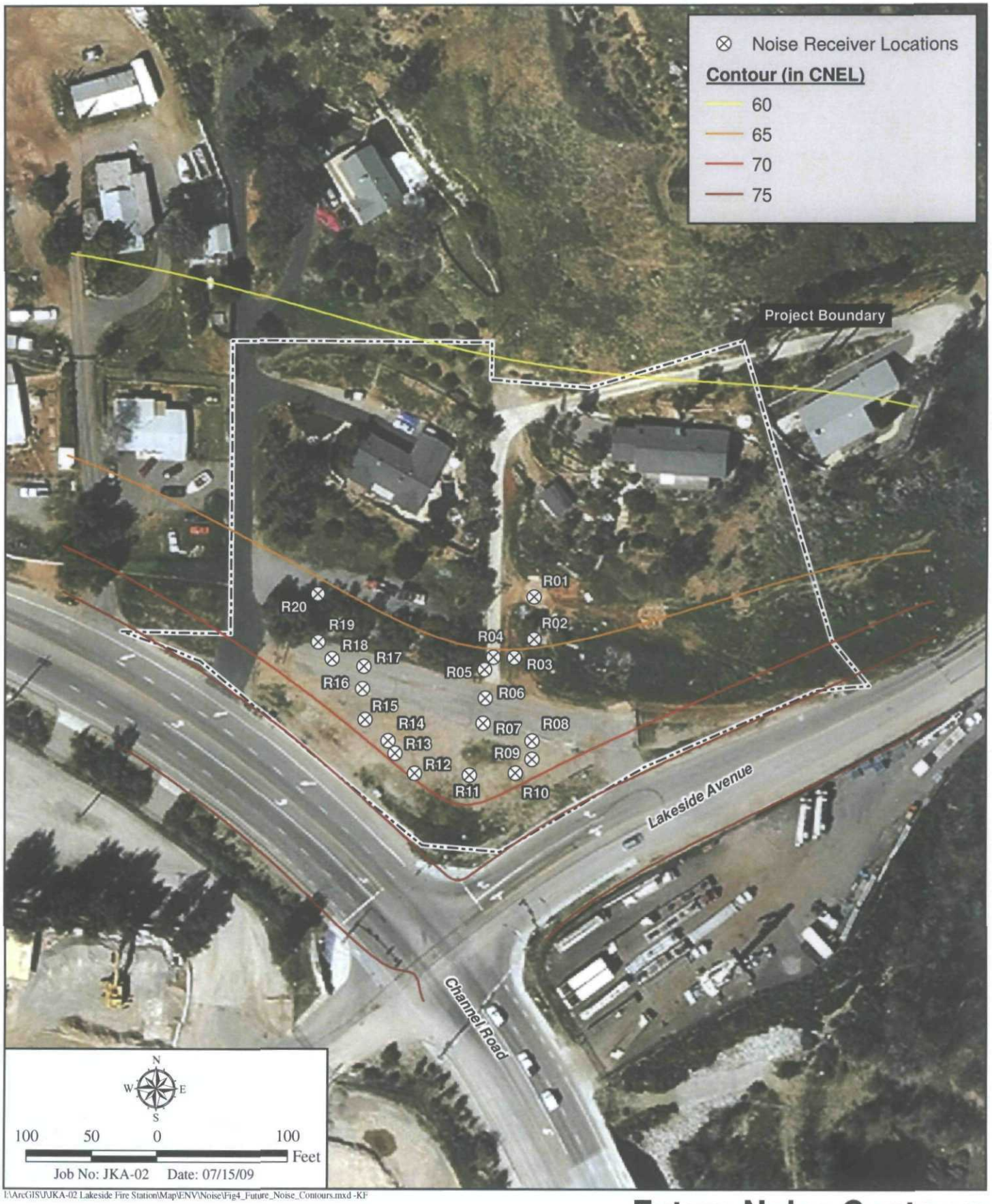
The project noise sources would include heating, ventilating, and air-conditioning (HVAC) units, kitchen ventilation units, and a diesel backup power generator. These sources are addressed in Section 3.0.

b. Design Considerations and Mitigation Measures

As mentioned above, the project may expose proposed on-site interior NSLUs (e.g., habitable space and office uses) to a significant amount of transportation noise. No other NSLUs would be significant impacted by the proposed project. Exterior to interior noise levels may be reduced significantly more than the 15 dBA standard construction attenuation by the use of enhanced glazing, enhanced wall design, and forced air ventilation. With these techniques it is readily feasible to build (or modify existing structures) to comply with the NSLU requirements.

c. Design Consideration Calculations

No topography design considerations were needed in the noise analysis model. Per the project description, the following architectural design considerations in the living quarters and office areas were included in the model:



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Future Noise Contours

LAKESIDE FIRE STATION NO. 2

HELIX

Figure 4

- Single layer of 7/8-inch thick stucco
- 2-inch wide by 6-inch deep wood studs, placed 16-inches on-center
- Single layer of 3 1/2-inch thick faced fiberglass batt insulation
- Double layer of 5/8-inch thick Type X gypsum board

INSUL evaluation of the exterior wall proposed for this project resulted in an approximate STC rating of 46, which was incorporated into this analysis. Please refer to Appendix D: Sound Insulation Prediction Results.

d. Mitigation Calculations

In order to mitigate the potential impact to proposed interior uses, the proposed project shall include the following measures in addition to the architectural building plan specifications at minimum:

- STC 28, 3/4-inch thick, dual insulating windows and sliding glass doors with window and glass door assemblies consisting of 1/8-inch glass, 1/2-inch air gap, and 1/8-inch glass.

- Exterior residential entrance doors must include all-around weather-tight door stop seals and an improved threshold closure system. It is imperative to seal and caulk between the door's rough opening and the finished door frame, using an acoustically resilient, non-skinning butyl caulking compound. This should be used as generously as possible, to ensure effective sound barrier isolation. The OSI Pro Series SC-175 acoustic sound sealant is a product specifically designed for this purpose. Head and jamb door seals are to be applied to the door frame stops. If the acoustical door stop seals are applied on top of the stops in the frame, the height and width of the opening is reduced, and the handle may require an extended offset for ease of operation.

- Appropriate means of air circulation and provision of fresh air must be present to allow windows to remain closed for extended intervals of time so that acceptable levels of noise can be maintained on the interior. The mechanical ventilation system shall meet the criteria of the Uniform Building Code (Chapter 12, Section 1203.3 of the 2001 California Building Code, based on the 1997 Uniform Building Code), including the capability to provide sufficient fresh air exchanges, as required by the Code. Fresh air must be supplied to individual rooms through a separate supply line duct controllable via a "Summer Switch" for circulation of unheated air. "Make-up air" must be supplied from the outside through a minimum 4-foot duct with two right-angle bends with interior duct insulation, or an equivalent design. The ventilation system shall not compromise the sound insulation capability of the exterior wall or be dependent on ventilation through windows.

The listed STC value is based on "Center-of-Glass" test data. Any window and frame configuration may be used as long as it meets or exceeds the minimum STC rating and corresponding octave band performance for the above window. Window "Center-of-Glass"

performance for the recommended window is provided in Appendix D: Sound Insulation Prediction Results.

As mentioned above, mitigation shall include s all-around weather-tight door stop seals and an improved threshold closure system on residential entrances. The additional hardware would improve the doors' overall sound reduction properties. The transmission loss (TL) of an exterior door without weather-tight seals is determined mostly by sound leakage, particularly at the bottom of the door if excessive clearance is allowed for air transfer. By equipping the exterior door with all-around weather-tight seals and a threshold closure at the bottom, the STC rating can be increased by approximately 10 points. For more information, please refer to Appendix E: Recommended Products. Also, refer to Appendix F: Excerpts of Typical Building Plans, Elevations, and Cross-sections.

Mechanical ventilation, which allows windows to be closed for extended intervals, is required for habitable residential space, as dictated by California Building Code Section 1208A.8.2. A Forced Air Unit (FAU) or its equivalent meeting the criterion described above must be installed in these spaces to satisfy code requirements.

The results of the exterior-to-interior noise analysis considering mitigation is summarized in Table 7. Where duplicate multiple rooms are shown on the plans, only a single room with the worst case exterior noise is analyzed. As shown in the Table, the proposed mitigation measures would allow for full mitigation of potential noise impacts. With the inclusion of 28 STC window specifications, all office space noise levels would be reduced to less than 50 dBA CNEL. With the inclusion of improved residential door sealing, 28 STC windows specifications, and the proper ventilation system to allow windows to be kept closed, all habitable space noise levels would be reduced to less than 45 dBA CNEL.

Table 7
NOISE LEVELS WITH MITIGATION

Unit Location and Room	Exterior Noise Level (dBA / CNEL)	Required STC	Mitigated Noise Level (dBA / CNEL)	
			Open Window Interior Noise	Closed Window Interior Noise
1st Floor				
Fitness	63.6	28 STC	40.9	28.7
Bunk	67.5	28 STC	54.0	36.3
Dining Room	65.7	28 STC	48.2	39.9
2nd Floor				
Fire Prevention	63.6	28 STC	49.6	32.2
Chief's Office	64.2	28 STC	48.5	36.5
Board Room	67.5	28 STC	47.1	36.1
Reception	65.7	28 STC	46.6	29.3

2.3 Cumulative Noise Impacts

Cumulative impacts were previously analyzed above, as the calculations of the off-site transportation noise sources for area future traffic. The Proposed Project would have a negligible contribution to the cumulative traffic along the adjacent roadways. The change of traffic noise due to the proposed project would be less than 0.2 dBA at any NSLU location and would be less than significant.

2.4 Conclusions

With the use of STC 28 windows, residential door sealing, and forced air ventilation, all impacts are mitigated to less than significant levels.

3.0 PROJECT-GENERATED AIRBORNE NOISE (OPERATION ACTIVITIES)

3.1 Guidelines for the Determination of Significance

Sound level limits are set forth in Section 36.404 Sound Level Limits, of the San Diego County Regulatory Ordinance, which states: that unless a variance has been applied for and granted, it shall be unlawful for any person to cause or allow the creation of any noise to the extent that the one-hour average sound level, at any point on or beyond the boundaries of the property on which the sound is produced, exceeds the applicable limits summarized in Table 8.

Table 8
SAN DIEGO COUNTY CODE SECTION 36.404 SOUND LEVEL LIMITS

ZONE	TIME	APPLICABLE LIMIT ONE-HOUR AVERAGE SOUND LEVEL (dB)
RS, RD, RR, RMH, A70, A72, S80, S81, S87, S88, S90, S92, RV, and RU. Use Regulations with a density of less than 11 dwelling units per acre.	7 a.m. to 10 p.m. 10 p.m. to 7 a.m.	50 45
RRO, RC, RM, C30, S86, RV, RU and V5. Use Regulations with a density of 11 or more dwelling units per acre.	7 a.m. to 10 p.m. 10 p.m. to 7 a.m.	55 50
S94, V4, and all other commercial zones	7 a.m. to 10 p.m. 10 p.m. to 7 a.m.	60 55
V1, V2 V1, V2 V1 V2	7 a.m. to 10 p.m. 10 p.m. to 7 a.m. 7 a.m. to 10 p.m. 10 p.m. to 7 a.m.	60 55 55 50

Table 8 (cont.) SAN DIEGO COUNTY CODE SECTION 36.404 SOUND LEVEL LIMITS		
ZONE	**TIME**	**APPLICABLE LIMIT ONE-HOUR AVERAGE SOUND LEVEL (dB)**
V3	7 a.m. to 10 p.m. 10 p.m. to 7 a.m.	70 65
(5) M50, M52, M54	Anytime	70
(6) S82, M58, and all other industrial zones.	Anytime	75
(7) S88 (see subsection (c) below)		

(b) Where a noise study has been conducted and the noise mitigation measures recommended by that study have been made conditions of approval of a Major Use Permit, which authorizes the noise-generating use or activity and the decision making body approving the Major Use Permit determined that those mitigation measures reduce potential noise impacts to a level below significance, implementation and compliance with those noise mitigation measures shall constitute compliance with subsection (a) above.

(c) S88 zones are Specific Planning Areas which allow different uses. The sound level limits in Table 8 above that apply in an S88 zone depend on the use being made of the property. The limits in Table 8, subsection (1) apply to property with a residential, agricultural or civic use. The limits in subsection

(3) apply to property with a commercial use. The limits in subsection (5) apply to property with an industrial use that would only be allowed in an M50, M52 or M54 zone. The limits in subsection (6) apply to all property with an extractive use or a use that would only be allowed in an M56 or M58 zone.

(d) If the measured ambient noise level exceeds the applicable limit in Table 36.404, the allowable one-hour average sound level shall be the one-hour average ambient noise level, plus three decibels. The ambient noise level shall be measured when the alleged noise violation source is not operating.

(e) The sound level limit at a location on a boundary between two zones is the arithmetic mean of the respective limits for the two zones. The one-hour average sound level limit applicable to extractive industries, however, including but not limited to borrow pits and mines, shall be 75 decibels at the property line regardless of the zone in which the extractive industry is located.

(f) A fixed-location public utility distribution or transmission facility located on or adjacent to a property line shall be subject to the sound level limits of this section measured at or beyond six feet from the boundary of the easement upon which the facility is located.

Other applicable sections of the County Noise Ordinance applicable to the project are Sections 36.409 and 36.410 (Construction Equipment), Sections 36.411 (Containers and Construction Materials), and Section 36.417 (Exemptions) as discussed in the following paragraphs.

Sec. 36.409—Sound Level Limitations on Construction Equipment

Except for emergency work, it shall be unlawful for any person to operate construction equipment or cause construction equipment to be operated, that exceeds an average sound level of 75 decibels for an eight-hour period, between 7 a.m. and 7 p.m., when measured at the boundary line of the property where the noise source is located or on any occupied property where the noise is being received.

(Amended by Ord. No. 9700 (N.S.), effective 2-4-05; amended by Ord. No. 9962 (N.S.), effective 1-9-09)

Sec. 36.410—Sound Level Limitations on Impulsive Noise

In addition to the general limitations on sound levels in section 36.404 and the limitations on construction equipment in section 36.409, the following additional sound level limitations shall apply:

(a) Except for emergency work or work on a public road project, no person shall produce or cause to be produced an impulsive noise that exceeds the maximum sound level shown in Table 36.410A, when measured at the boundary line of the property where the noise source is located or on any occupied property where the noise is received, for 25 percent of the minutes in the measurement period, as described in subsection (c) below. The maximum sound level depends on the use being made of the occupied property. The uses in Table 36.410A are as described in the County Zoning Ordinance.

Table 36.410A.
MAXIMUM SOUND LEVEL (IMPULSIVE) MEASURED AT OCCUPIED PROPERTY IN DECIBELS (dBA)

OCCUPIED PROPERTY USE	DECIBELS (dBA)
Residential, village zoning or civic use	82
Agricultural, commercial or industrial use	85

(b) Except for emergency work, no person working on a public road project shall produce or cause to be produced an impulsive noise that exceeds the maximum sound level shown in Table 36.410B, when measured at the boundary line of the property where the noise source is located or on any occupied property where the noise is received, for 25 percent of the minutes in the measurement period, as described in subsection (c) below. The maximum

sound level depends on the use being made of the occupied property. The uses in Table 36.410B are as described in the County Zoning Ordinance.

Table 36.410B. MAXIMUM SOUND LEVEL (IMPULSIVE) MEASURED AT OCCUPIED PROPERTY IN DECIBELS (dBA) FOR PUBLIC ROAD PROJECTS	
OCCUPIED PROPERTY USE	**DECIBELS (dBA)**
Residential, village zoning or civic use	85
Agricultural, commercial or industrial use	90

(c) The minimum measurement period for any measurements conducted under this section shall be one be one hour. During the measurement period a measurement shall be conducted every minute from a fixed location on an occupied property. The measurements shall measure the maximum sound level during each minute of the measurement period. If the sound level caused by construction equipment or the producer of the impulsive noise exceeds the maximum sound level for any portion of any minute, it will be deemed that the maximum sound level was exceeded during that minute.

(Added by Ord. No. 9962 (N.S.), effective 1-9-09)

Sec. 36.411. Containers and Construction Material states that it shall be unlawful for any person to handle or transport or cause to be handled or transported in any public place, any container or any construction material in such a way as to create a disturbing, excessive, or offensive noise as defined under Section 36.402(s) of the Chapter 4 of the San Diego County Regulatory Ordinance.

Sec. 36.417. Exemptions identifies the following activities as being exempt from Chapter 4 of the San Diego County Regulatory Ordinance

(a) Emergency Work. The provisions of this chapter shall not apply to any emergency work as defined herein, provided that (1) the noise Control Officer has been notified in advance, if possible, or as soon as practical after said emergency, and (2) any vehicle device, apparatus, or equipment used, related to or connected with emergency work is designed, modified, or equipped to reduce sounds produced to the lowest possible level consistent with effective operation of such vehicle, device, apparatus, or equipment.

(b) Sporting, Entertainment, Public Events. The provisions of this chapter shall not apply to:
   (1) Those reasonable sounds emanating from authorized school bands, school athletic and school entertainment events.
   (2) Sporting, entertainment and public events which are conducted pursuant to a license or permit issued by the County of San Diego for noise exceeding criteria, standards or levels as set forth in this chapter.

(3) Those reasonable sounds emanating from a sporting, entertainment, or public event; provided, however, it shall be unlawful to exceed those levels set forth in Section 36.404 when measured at or within the property lines of any property which is developed and used either in part or in whole for residential purposes unless a variance has been granted allowing sounds in excess of said levels.

(4) The operation of an emergency generator after a power failure, by an employee or agent of a law enforcement agency, fire department, hospital or other medical or surgical facility that is providing emergency medical services.

(5) The reasonable testing of an emergency generator by any person provided that the testing is conducted between the hours of 7 a.m. and 7 p.m.

(6) Any activity preempted by State or federal law.

(c) Federal or State Preempted Activities. The provisions of this chapter shall not apply to any activity to the extent regulation thereof has been preempted by State or Federal law.

(d) Minor Maintenance to Residential Property. The provisions of Section 36.404 shall not apply to noise sources associated with minor maintenance to property used either in part or in whole for residential purposes provided said activities take place between the hours of 7 a.m. and 8 p.m. on any day except Sunday, or between the hours of 10 a.m. and 8 p.m. on Sunday.

(e) Agricultural Operations. The provisions of Section 36.404 shall not apply to equipment associated with agricultural operations, provided that, all equipment and machinery powered by internal-combustion engines is equipped with a proper muffler and air intake silencer in good working order, and provided further that:

(1) Operations do not take place between 7 p.m. and the following 7 a.m.; or

(2) Such operations and equipment are utilized for the preparation, planting, harvesting, protection or salvage of agricultural crops during periods of potential or actual frost damage or other adverse weather conditions; or

(3) Such operations and equipment are associated with agricultural pest control, provided the application is made in accordance with regulations or procedures administered by the County Department of Agriculture; or

(4) Such operations and equipment are associated with the application of agricultural chemicals provided the application is made in accordance with acceptable agricultural practices or upon the recommendation of an agricultural specialist.

3.2 Potential Operational Noise Impacts (Non-construction Noise)

a. Potential Build-out Noise Conditions Without Mitigation

Off-site Non-transportation Noise

No non-compliant off-site non-transportation noise sources were observed during the site visit. As mentioned in Section 2, the operations of surrounding uses generate minimal non-transportation noise.

On-site Transportation Noise

Refer to Section 2.0 for this analysis. It is noted that negligible noise from on-site traffic and parking would occur.

On-site Non-Transportation Noise

HVAC and Air Exhaust Systems

The proposed project includes the future outdoor installation of HVAC condenser units and air exhaust fans in equipment wells in the roof of the proposed buildings (Figure 4). The equipment wells would be shielded by 6-foot high (or higher) parapet walls to block noise and views. The cut sheets for the various pieces of equipment are shown in Appendix G. Shielded behind parapet walls at least as tall as the tallest piece of adjacent equipment, the combined roof-mounted HVAC and air exhaust units would create a worst-case property line northern property line impact of 32.0 dBA L_{EQ} when all units are operating. Areas of the adjacent hillside looking down at the unit would have overall noise impacts as high as 41.0 dBA. This is less than the allowable nighttime residential property line limit of 45 dBA. Figure 5 provides a graphic display of HVAC impacts.

Backup Generator

An on-site backup power generator is proposed as a part of the new fire station. This generator would be installed near the southeastern corner of the building. The planned unit is a Kohler 450 REOZDD equipped with a Level 2 Standard Sound Enclosure. The manufacturer's specifications indicate a maximum system noise of 75 dBA at 7-meters (23-feet). The generator would be enclosed in a grouted concrete block (CMU) wall taller than the maximum unit height. The generator cut sheets are supplied as Appendix H.

The backup generator would have the worst impact at the southeastern property line that is near the vehicle storage area (Figure 6). The property line between the vehicle storage area and the proposed project would experience a noise level of 50 dBA when the generator is running. The impact to the north at the probable future residential property would also be approximately 50 dBA, with impacts at the face of the closest residence are approximately 45 dBA. The operation of a backup power generator by a fire station is specifically excluded from the noise control ordinances, and therefore the impact would be less than significant.

The operation of a backup power generator by a fire station is specifically excluded from the noise control ordinances Section 36.417, Exemptions. The information on the backup generator noise impacts is presented for information only.

b. Design Considerations and Mitigation Measures

The following project features were assumed in the operational analysis above:

- All air conditioning units must be shielded from a direct visual line-of-sight by parapet walls as high as the top of the highest unit in the equipment well.
- The individual HVAC units must have a manufacturers Sound Power Rating of less than which do not exceed those of the provide in the attachments

I:\ArcGIS\U\JKA-02 Lakeside Fire Station\Map\ENV\Noise\Fig5_HVAC_Noise_Contours.mxd -KF

HVAC Noise Map

LAKESIDE FIRE STATION NO. 2

HELIX

Figure 5

I:\ArcGIS\J\JKA-02 Lakeside Fire Station\Map\ENV\Noise\Fig6_Generator_Noise_Contours.mxd -KF

Generator Noise Contours

LAKESIDE FIRE STATION NO. 2

HELIX

Figure 6

- The Generator needs to be equipped with the manufacturer's level 2 enclosure with a maximum noise source level of 75 dBA at 23 feet.

- The generator should be enclosed in a CMU wall as high or higher than the top of the skid mounted unit.

No significant operational noise impacts would result from the proposed project and therefore no operational mitigation is required.

3.3 Potential General Construction Noise Impacts

Site construction would entail the use of heavy equipment throughout the site for the full term of construction. As detailed in the project description, construction activities include seven general phases that may overlap. The equipment used in each of these phases is identified in the project description. The topography assumed is shown on the site plan (Figure 3). Below is the construction noise impact analysis. See Appendix I, U.S. Department of Transportation Construction Equipment Noise Data Tables.

Rough Grading

No soils report is available; however, it is unlikely that any material removal would require the use of blasting or breaking. The highest impact level at the adjacent property, north of the probable site high point should be less than the allowed 75 dBA eight hour average. Thus, construction noise impact during the rough grading phases would be less than significant (Figure 7)

Foundation Excavation, Foundation Pour, Utilities Excavation, Building Construction, Finish Grading

The site planning is based on building construction no closer than 75 feet to any property line. Given the type and size of the proposed buildings, these construction activities are unlikely to exceed acceptable noise levels and are therefore not analyzed. Thus, construction noise impacts during these phases are assumed to be less than significant.

Cumulative or Combined Noise Impacts

Based on the size and type of construction, noise impacts for the site would not have a cumulative impact at the residences to the north of the site. The addition of the Project construction noise at any locations beyond the immediately adjacent properties would be below the established ordinance levels.

Mitigation Measures

No design considerations or mitigation measures are required as construction noise impacts would be less than significant.

3.4 Cumulative or Combined Noise Impacts

a. Potential Cumulative or Combined Noise Impacts

The overall operational noise levels would not be cumulatively considerable.

b. Design Considerations and Mitigation Measures

No mitigation is necessary, as cumulative operational impacts would be less than significant. As identified under the potential direct noise impacts, the following design considerations shall be included in the project under the cumulative conditions:

- All Air conditioning units must be shielded from a direct visual line-of-sight by parapet walls as high as the top of the highest unit in the equipment well.
- The individual HVAC units must have a manufacturers Sound Power Rating of less than which do not exceed those of the provide in the attachments
- The Generator needs to be equipped with the manufacturer's level 2 enclosure with a maximum noise source level of 75 dBA at 23 feet.
- The generator should be enclosed in a CMU wall as high or higher than the top of the skid mounted unit.

3.5 Conclusions

With the design considerations as described above, all known on-site and off-site individual and cumulative impacts can be controlled to a less than significant operation activities condition.

4.0 GROUND-BORNE VIBRATION AND NOISE IMPACTS

4.1 Guidelines for the Determination of Significance

Impacts associated with ground-borne vibration and noise would be significant if project implementation will expose the uses listed in Table 9 and 10 to ground-borne vibration or noise levels equal to or in excess of the levels shown:

I:\ArcGIS\J\JKA-02 Lakeside Fire Station\Map\ENV\Noise\Fig7_Construction_Noise_Contours.mxd -NM

Construction Equipment Noise Contours

LAKESIDE FIRE STATION NO. 2

HELIX

Figure 7

Table 9
GUIDELINES FOR DETERMINING THE SIGNIFICANCE OF GROUND-BORNE VIBRATION AND NOISE IMPACTS

Land Use Category	Ground-Borne Vibration Impact Levels (inches/sec rms)		Ground-Borne Noise Impact Levels (dB re 20 micro Pascals)	
	Frequent Events[1]	Infrequent Events[2]	Frequent Events[1]	Infrequent Events[2]
Category 1: Buildings where low ambient vibration is essential for interior operations. (research & manufacturing facilities with special vibration constraints)	0.0018 [3]	0.0018 [3]	Not applicable[5]	Not applicable[5]
Category 2: Residences and buildings where people normally sleep. (hotels, hospitals, residences, & other sleeping facilities) [6]	0.0040	0.010	35 dBA	43 dBA
Category 3: Institutional land uses with primarily daytime use. (schools, churches, libraries, other institutions, & quiet offices) [6]	0.0056	0.014	40 dBA	48 dBA

Source: U.S. Department of Transportation, Federal Transit Administration, "Transit Noise and Vibration Impact Assessment," May 2006.

1. "Frequent Events" is defined as more than 70 vibration events per day. Most rapid transit projects fall into this category.
2. "Infrequent Events" is defined as fewer than 70 vibration events per day. This category includes most commuter rail systems.
3. This criterion limit is based on levels that are acceptable for most moderately sensitive equipment such as optical microscopes. Vibration sensitive manufacturing or research will require detailed evaluation to define acceptable vibration levels. Ensuring lower vibration levels in a building often requires special design of the HVAC systems and stiffened floors.
4. Vibration-sensitive equipment is not sensitive to ground-borne noise.
5. There are some buildings, such as concert halls, TV and recording studios, and theaters that can be very sensitive to vibration and noise but do not fit into any of the three categories. Table 4 gives criteria for acceptable levels of ground-borne vibration and noise for these various types of special uses.
6. For Categories 2 and 3 with occupied facilities, isolated events such as blasting are significant when the peak particle velocity (PPV) exceeds one inch per second. Continuous or frequent intermittent vibration sources such as impact pile drivers are significant when their PPV exceeds 0.1 inch per second. . More specific criteria for structures and potential annoyance were developed by Caltrans (2004) and will be used to evaluate these continuous or transient sources in San Diego County.

Table 10 GUIDELINES FOR DETERMINING THE SIGNIFICANCE OF GROUND-BORNE VIBRATION AND NOISE IMPACTS FOR SPECIAL BUILDINGS				
Type of Building or Room	**Ground-borne Vibration Impact Levels (inches/sec rms)**		**Ground-borne Noise Impact Levels (dB re 20 micro Pascals)**	
	Frequent Events[1]	**Infrequent Events[2]**	**Frequent Events[1]**	**Infrequent Events[2]**
Concert Halls, TV Studios and Recording Studios	0.0018	0.0018	25 dBA	25 dBA
Auditoriums	0.0040	0.010	30 dBA	38 dBA
Theaters	0.0040	0.010	35 dBA	43 dBA

Source: U.S. Department of Transportation, Federal Transit Administration, "Transit Noise and Vibration Impact Assessment," May 2006.

1. "Frequent Events" is defined as more than 70 vibration events per day. Most rapid transit projects fall into this category.
2. "Infrequent Events" is defined as fewer than 70 vibration events per day. This category includes most commuter rail systems.

4.2 Potential and Mitigated Vibration Impacts

No post-construction on-site or observed off-site sources have the potential of creating ground-borne vibration or low frequency noise of significance. No rough grading operation during project construction has the potential of creating significant ground borne vibration or low frequency noise. Therefore, vibration impacts are considered less than significant and no vibration mitigation or design considerations are required.

5.0 SUMMARY OF PROJECT IMPACTS, DESIGN CONSIDERATIONS, NOISE MITIGATION AND CONCLUSION

Impacts

The proposed project could result in the exposure of proposed on-site NSLUs to transportation noise that exceeds the County's guidelines. No other construction, operational, cumulative, or vibration impact would occur.

Design Considerations

- All air conditioning units must be shielded from a direct visual line-of-sight by parapet walls as high as the top of the highest unit in the equipment well.
- The individual HVAC units must have a manufacturers Sound Power Rating of less than which do not exceed those of the provide in the attachments
- The Generator needs to be equipped with the manufacturer's level 2 enclosure with a maximum noise source level of 75 dBA at 23 feet.
- The generator should be enclosed in a CMU wall as high or higher than the top of the skid mounted unit.

Although not proposed as a design consideration or needed as mitigation, if noise barriers are proposed they shall adhere to the following specifications:

> A sound attenuation fence/wall should be solid and constructed of masonry, wood, plastic, fiberglass, steel, or a combination of those materials, with no cracks or gaps, through or below the wall. Any seams or cracks must be filled or caulked. If wood is used, it can be tongue and groove and must be at least 1-inch total thickness or have a density of at least 3½ pounds per square foot. Where architectural or aesthetic factors allow, glass or clear plastic may be used on the upper portion, if it is desirable to preserve a view. Sheet metal of 18-gauge (minimum) may be used, if it meets the other criteria and is properly supported and stiffened so that it does not rattle or create noise itself from vibration or wind. Any door(s) or gate(s) must be designed with overlapping closures on the bottom and sides and meet the minimum specifications of the wall materials described above. The gate(s) may be of 1-inch thick or better wood, solid-sheet metal of at least 18-gauge metal, or an exterior-grade solid-core steel door with prefabricated door jambs.

Mitigation

In order to mitigate the potential impact to proposed interior uses, the proposed project shall include the following minimum measures:

- STC 28, 3/4-inch thick, dual insulating windows and sliding glass doors with window and glass door assemblies consisting of 1/8-inch glass, 1/2-inch air gap, and 1/8-inch glass.

- Exterior residential entrance doors must include all-around weather-tight door stop seals and an improved threshold closure system. It is imperative to seal and caulk between the door's rough opening and the finished door frame, using an acoustically resilient, non-skinning butyl caulking compound. This should be used as generously as possible, to ensure effective sound barrier isolation. The OSI Pro Series SC-175 acoustic sound sealant is a product specifically designed for this purpose. Head and jamb door seals are to be applied to the door frame stops. If the acoustical door stop seals are applied on top of the stops in the frame, the height and width of the opening is reduced, and the handle may require an extended offset for ease of operation.

- Appropriate means of air circulation and provision of fresh air must be present to allow windows to remain closed for extended intervals of time so that acceptable levels of noise can be maintained on the interior. The mechanical ventilation system shall meet the criteria of the Uniform Building Code (Chapter 12, Section 1203.3 of the 2001 California Building Code, based on the 1997 Uniform Building Code), including the capability to provide sufficient fresh air exchanges, as required by the Code. Fresh air must be supplied to individual rooms through a separate supply line duct controllable via a "Summer Switch" for circulation of unheated air. "Make-up air" must be supplied from the outside through a minimum 4-foot duct with two right-angle bends with interior duct insulation, or an equivalent design. The ventilation system shall not compromise the sound insulation capability of the exterior wall or be dependent on ventilation through windows.

Conclusion

With the design considerations and mitigation described above, no significant noise impacts would occur.

6.0 CERTIFICATION

This report is based on the related project information received and measured noise levels, and represents a true and factual analysis of the acoustical impact issues associated with the construction and use of the proposed Lakeside Fire Station 12224 Lakeside Avenue, Lakeside, California.

This report was prepared by Charles Terry, County-approved CEQA Consultant for Acoustics and Noise.

APPENDIX A

References

Appendix A

REFERENCES

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Noise Element to the General Plan.

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1974. California Noise Insulation Standards California Administrative Code, Title 24. Adopted February 14.

2001. 2001 California Building Code, Based on the 1997 Uniform Building Code, Title 24, Part 2, Volume 1, Appendix Chapter 12, Division II - Sound Transmission Control, Section 1208 - Sound Transmission Control.

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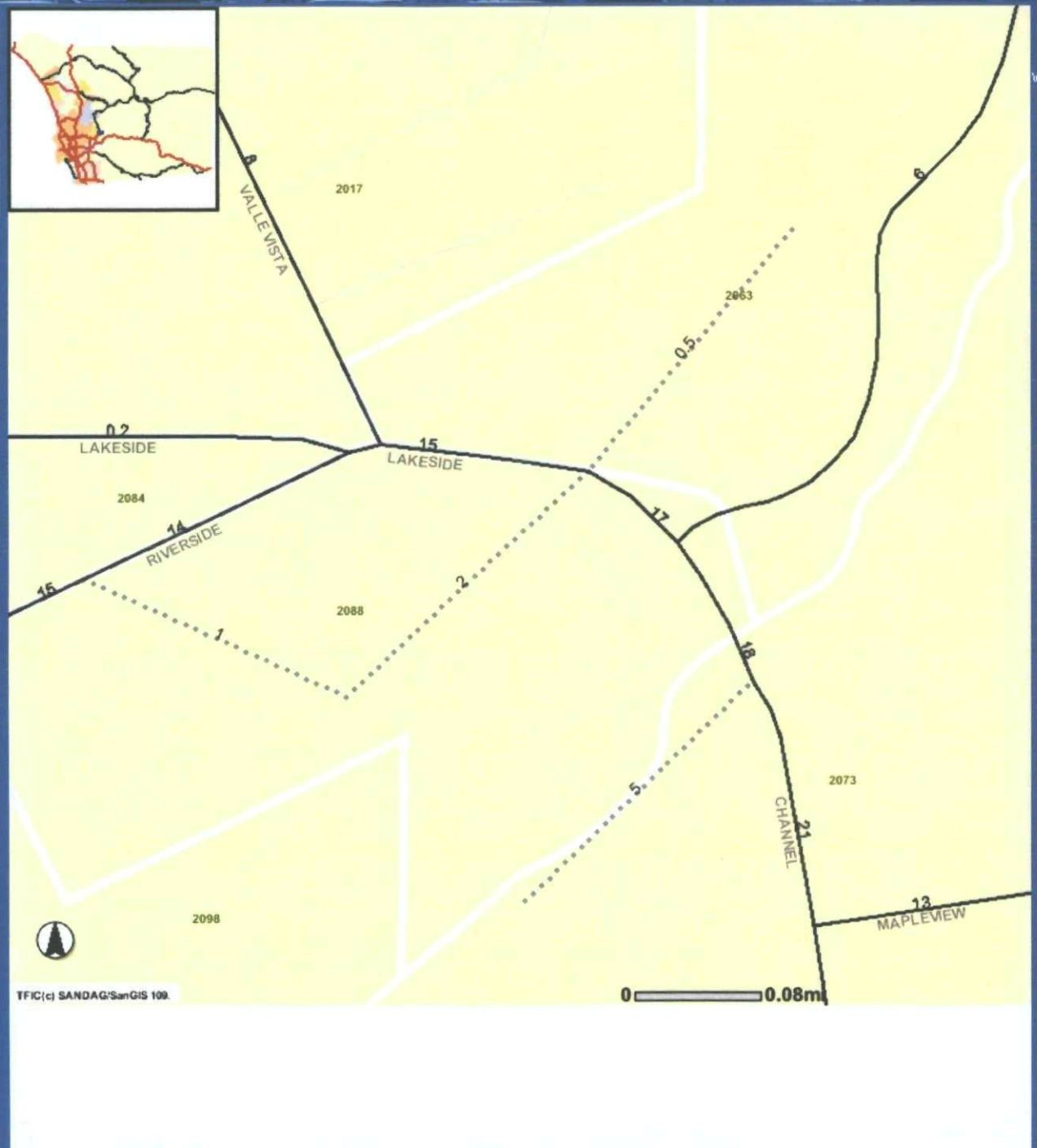
APPENDIX B

SANDAG Traffic Data


SANDAG
Series 11 Traffic Forecast 2003
2017
VALLE VISTA
2063
0.1
1
0.1
LAKESIDE
2084
12
LAKESIDE
10
RIVERSIDE
14
2
0.8
2088
15
2073
3
18
CHANNEL
2098
TFIC(c) SANDAG/SanGIS 109.
0
0.059mi
Layers
Visible Active
Freeways
Freeway Stations
Roads
Local Roads
Zone Connectors
Traffic Analysis Zones
Road Names
Jurisdictions
Refresh Map
Zone 13
Report
Zoom In
HELP
2010
2020
2030
All Years

SANDAG Series 11 Traffic Forecast 2020



Layers

Visible Active

- Freeways
- Freeway Stations
- Roads
- Local Roads
- Zone Connectors
- Traffic Analysis Zones
- Road Names
- Jurisdictions

Refresh Map

Zone 13

Report

Zoom In

HELP 2003 2010 2030 All Years


SANDAG
Series 11 Traffic Forecast 2030
Layers
Visible Active
Freeways
Freeway Stations
Roads
Local Roads
Zone Connectors
Traffic Analysis Zones
Road Names
Jurisdictions
Refresh Map
Zone 13
Report
2063
2088
2073
17
LAKESIDE
CHANNEL
TFIC(c) SANDAG/SanGIS 109.
0
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Zoom In
HELP
2003
2010
2020
All Years

APPENDIX C

TNM Modeling Data

Data available Electronically by Request

APPENDIX D

Sound Insulation Prediction Results

Sound Insulation Prediction (v6.2)

Promat

Margin of error is generally within +/- 3STC

Job Name:NASNI

Notes:

Job No.:NP09070

Page No.:

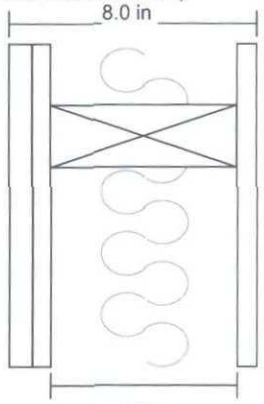
Date: 16 Jul 09

Initials:CharlesT

File Name:insul

1 x 0.8 in Lightweight concrete
1 x 0.6 in OSB (Oriented Strand Board)

1 x 0.6 in Type X Gypsum Board



STC 46
OITC 41

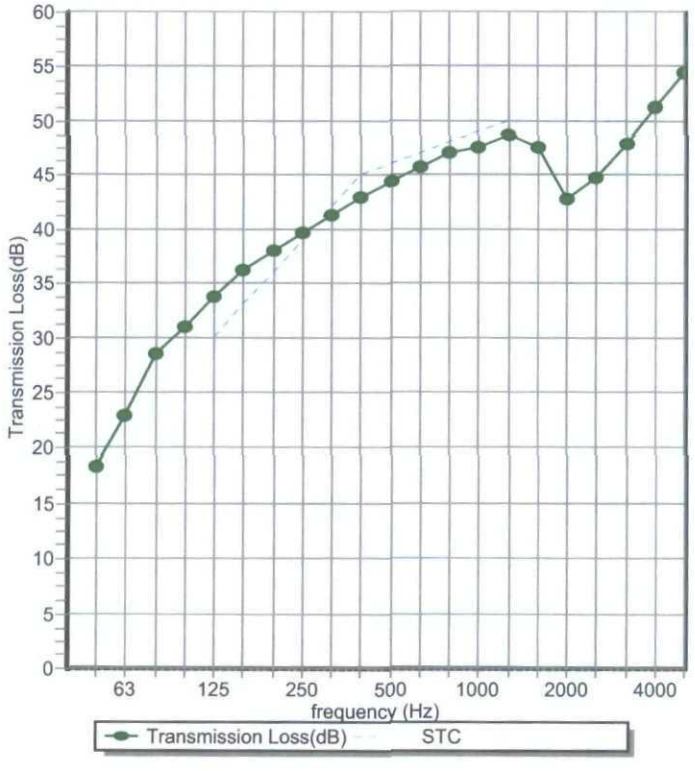
Surface Mass 5.1 lb/ft2
Surface Mass 1.7 lb/ft2
Critical Freq 2019 Hz
Critical Freq 1651 Hz
damping 0.02
Panel damping 0.03

fo =54 Hz

Surface Mass 2.2 lb/ft2
Critical Freq 2511 Hz
damping 0.01

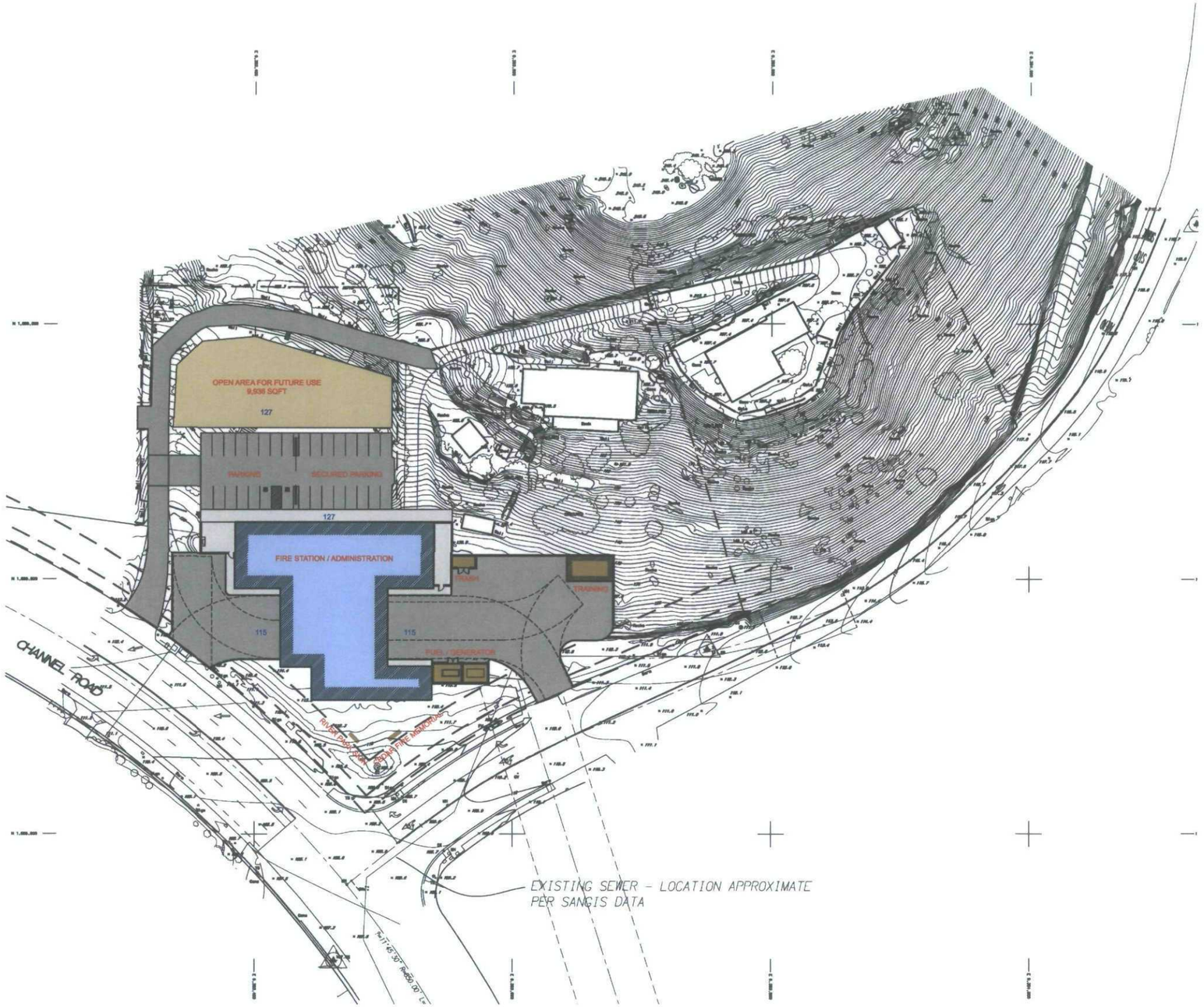
Infill 3" fiberglass (0.6 lb/ft3) Thickness 2.95 in

frequency (Hz)	TL(dB)	TL(dB)
50	18	
63	23	21
80	28	
100	31	
125	34	33
160	36	
200	38	
250	40	39
315	41	
400	43	
500	44	44
630	46	
800	47	
1000	47	48
1250	49	
1600	47	
2000	43	45
2500	45	
3150	48	
4000	51	50
5000	54	



APPENDIX E

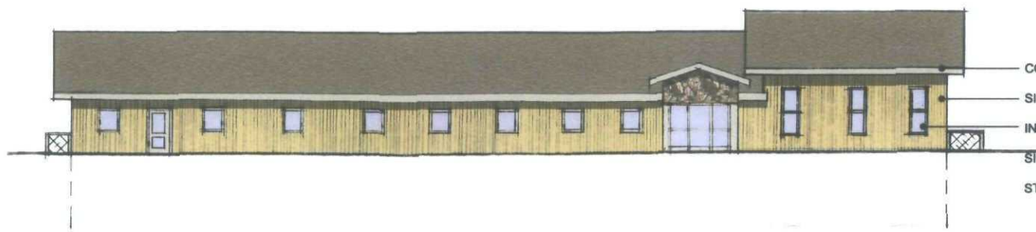
Excerpts from Typical Building Plans, Elevations, and Cross-sections



SITE PLAN

LAKESIDE FIRE STATION #2

jeff katz ARCHITECTURE



NORTH

EAST

SOUTH

WEST

PERSPECTIVE

LAKESIDE FIRE STATION #2

jeff katz ARCHITECTURE

FIRST FLOOR PLAN

LAKESIDE FIRE STATION #2

jeffkatz ARCHITECTURE

SECOND FLOOR PLAN

APPENDIX F

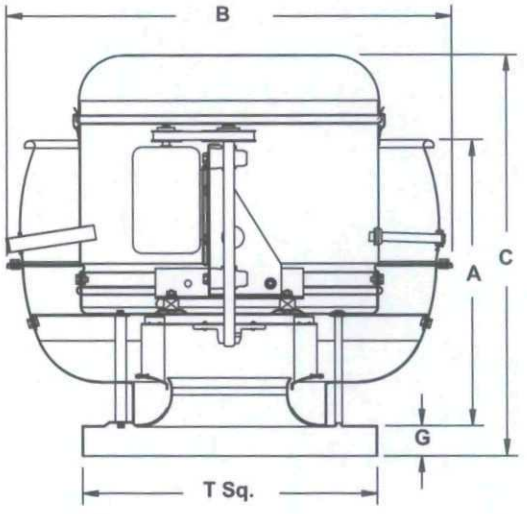
HVAC Cut Sheets

COOK

MARK: EF-1,2 (ALT.)
PROJECT: LAKESIDE FS
DATE: 07-01-2009

ACRU-B

Upblast Centrifugal
Exhaust Ventilator
Roof Mounted/Belt Drive



STANDARD CONSTRUCTION FEATURES:

All aluminum housing - Backward inclined all aluminum wheel - Two piece top cap with stainless steel quick release latches - One piece bottom spinning - Welded curb cap corners - Birdscreen - Vibration isolators - Lifting Lugs - Permanently lubricated ball bearing motors - Static resistant belts - Adjustable pitch drives through 5 hp motor - Corrosion resistant fasteners - Regreasable bearings in a cast iron pillow block housing, rated at 200,000 hours average life - All fans factory adjusted to specified fan RPM - Transit tested packaging. Standard motors ship factory installed.

Performance (*Bhp includes 13% drive loss)

Qty	Catalog Number	Flow (CFM)	SP (inwc)	Fan RPM	Bhp* (HP)
2	195R6B	3000	.500	814	.508

Altitude (ft): 500 Temperature (F): 70

Motor Information

HP	RPM	Volts/Ph/Hz	Enclosure	Mounted
3/4	1725	460/3/60	TEFC	Yes

Sound Data 8 Octave Bands dB (10^{-12} Watts)

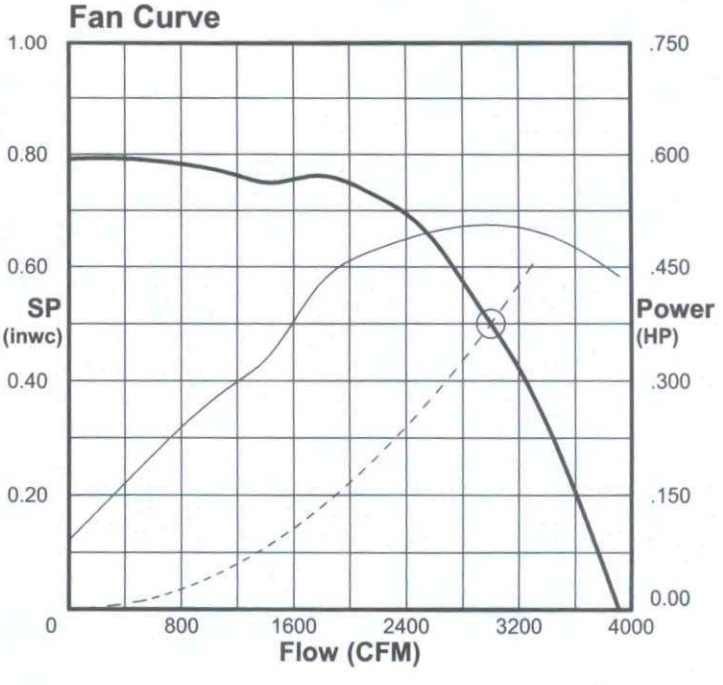
1	2	3	4	5	6	7	8	LwA	dBA	Sones
71	76	75	66	61	59	54	51	70	58	9.6

Dimensions (inches)

A	24-13/16
B	39-7/16
C	36-3/8
G	3
T Sq.	30
Roof Open. Sq.*	25-1/2
Unit Wt(lbs)***	129

* Roof opening size for curbs supplied by Cook only.
***Includes fan, motor & accessories.

Fan Curve

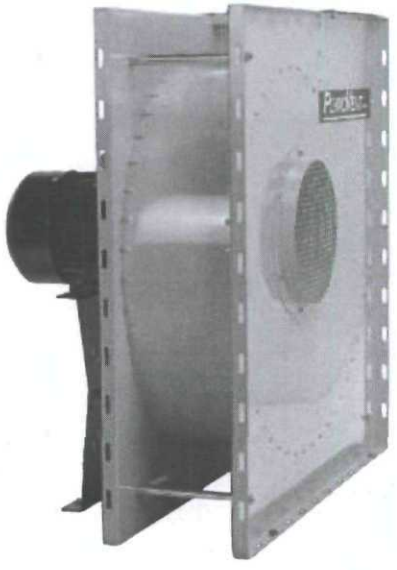


Fan Curve Legend

CFM vs SP	———
CFM vs HP	———
System Curve	- - -
Point of Operation	○

TEV-765-50

The Energy saving Ventilator



ENERGY CONSERVATION

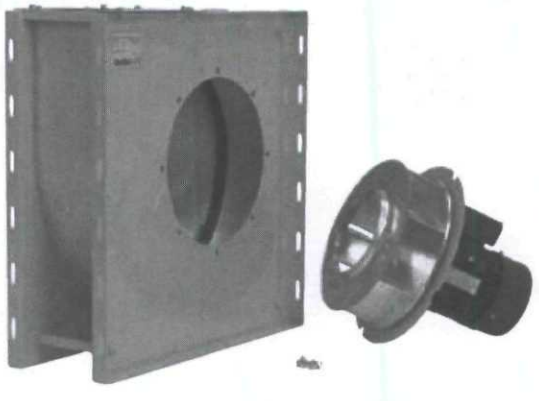
PlymoVent's mission is to design energy efficient products. PlymoVent utilises as standard equipment Energy Efficient Motors. This standard in conjunction with our new design produces the lowest operating cost fan package offered in the world today. If you have an existing fan, you can replace it with a PlymoVent and reduce your operating costs and in turn receive a return on your investment. Not many other products can stand behind that claim.

POWER CONSUMPTION

PlymoVent fans require less kW versus air volume delivered. This does not only equate to less power consumption but also less installation cost. This allows the electrical installer to reduce the cost of installation by reducing the associated components required to run the motor.

EASY ACCESS IMPELLER

All PlymoVent fan housings are designed for easy access to the impeller. Our design allows an installer or service technician to remove the motor and impeller wheel without removing inlet or outlet ductwork or disassembling the fan housing. It also provides the installer the option of separating the fan into two pieces when mounting in confined locations above drop ceilings or tight access ways.



AIRFOIL IMPELLER

PlymoVent in co-operation with an internationally recognized university, has designed the ultimate airfoil fan impeller. Through the use of aerospace design techniques, PlymoVent has been successful in designing a fan impeller that maximises air delivery at higher static pressures and reduces energy consumption at the same time. PlymoVent fans deliver the air volume you need at 30% less energy required over any competitive fan.

PLYMOVENT®

www.plymovent.co.uk

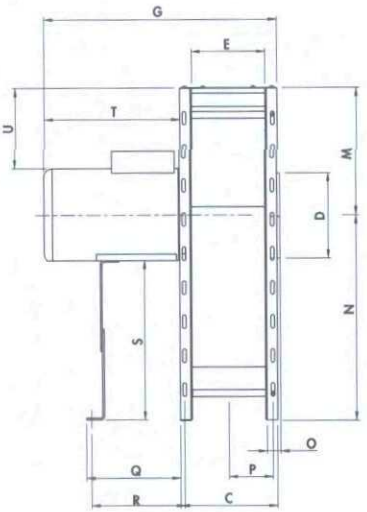
CE

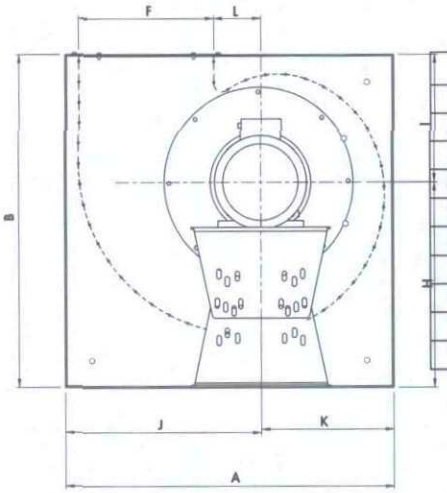
DNV SS-EN ISO 9001

Model: TEV-765-50

DIMENSIONAL DATA

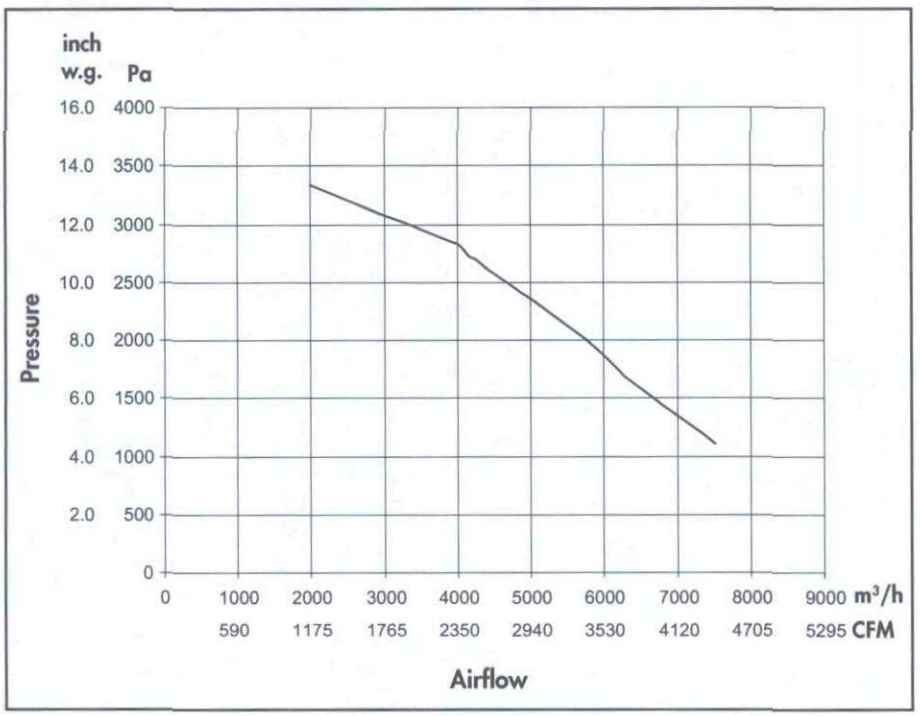
	mm	inches
A	980	38 19/32
B	980	38 19/32
C	290	5 11/16
D	250	9 27/32
E	220	8 21/32
F	402	15 13/16
G	695	27 3/8
H	603	23 3/4
I	377	14 27/32
J	583	22 15/16
K	397	15 5/8





	mm	inches
L	140	5 1/2
M	377	14 27/32
N	603	23 3/4
O	41	1 5/8
P	145	5 11/16
Q	279	11
R	282	11 3/32
S	468	18 15/32
T	405	15 15/16
U	240	9 7/16

TECHNICAL DATA



Measurement in accordance with *SS ISO-5801*.

Fan specifications

Construction:	AMCA Type - B
Drive type:	Direct drive
Impeller type:	Backward incline
Impeller material:	Aluminium
Impeller diameter:	500 mm / 19.68 inch
Impeller width:	65 mm / 2.56 inch
Hub size:	28 mm / 1.1 inch
Discharge style:	Rotational 90°
Shaft seal:	Rubber
Housing material:	Galvanized steel
Housing finish:	Epoxy powder coat
Total fan weight:	78 kg / 172 lbs

Motor specifications

Frame size:	IEC IA112M1-2
Shaft size:	28 mm / 1.1 inch
Motor:	4 kW
Motor RPM:	2887 rpm
Service factor:	1.15
Thermal protection:	No
CE-listed:	Yes

Electrical power is available for all international electrical power sources.

SOUND POWER DATA

Octave Band (Hz)	63	125	250	500	1000	2000	4000	LwA
Sound power (dB)	86.4	84.1	86.4	81.6	84.0	78.7	74.8	87.1

The sound power measurement in accordance with SS ISO-5135.

PLYMOVENT®

PlymoVent representative

Marley Way, Southam Road, Banbury, Oxfordshire OX16 2RA
Tel: (01295) 25 93 11, Fax: (01295) 27 17 50
www.plymovent.co.uk info@plymovent.co.uk

TIN_765-50_040511_EN

CITY MULTI® Outdoor Unit: 20-TON PURY-P240TSHMU-A

MITSUBISHI ELECTRIC

(Consists of Two PURY-P120THMU-A and One CMY-R100VBK Twinning Kit)

Job Name: Location:

Drawing Reference: Schedule No.

System No.: Date:

OUTDOOR VRFZ HEAT RECOVERY SYSTEM FEATURES

- 3-phase, 208/230V systems
- Modular variable refrigerant flow zoning (VRFZ) systems; smaller capacity units can be piped together to form a single, large-capacity two-pipe system
- Compact size for each outdoor module; can be transported through standard-sized doorways for installation
- Required Twinning Kit allows for easy field piping connection
- Selectable fan static, 0.12 or 0.24"WG external static pressure; factory set to 0"WG
- Max. Total Refrigerant Piping Length: 1,804' (P72,96); 1,969' (P120,144,168); 2,461' (P192); 2,625' (P216,240); Max. Refrigerant Line Length: 541'; Max. Control Wiring Length: 1,650'
- Connects to CITY MULTI indoor units; controlled via CITY MULTI Controls Network (CMCN)
- External finish: Pre-coated Galvanized-steel Sheets
- Operating Temperature Range
  Cooling (Outdoor): 23° ~ 109°F (-5° ~ +43°C) DB
  Heating (Outdoor): -4° ~ +60°F (-20° ~ +16°C) WB

PURY-P120THMU-A PURY-P120THMU-A

INVERTER

R410A

OPTIONAL PARTS

- ☐ Twinning Kit*.....CMY-R100VBK
- ☐ Branch Joint (T-Branch: ≤ 72,000 Btu/h).....CMY-Y102S-G2
- ☐ Branch Joint (T-Branch: 73,000-144,000 Btu/h).....CMY-Y102L-G2
- ☐ Joint Adapter (Port Connector>54,000 Btu/h)..... CMY-R160J
- ☐ Main BC Controller.....CMB-P108/1010/1013/1016NU-GA
- ☐ Sub BC Controller.....CMB-P104/108NU-GB/-1016NU-HB

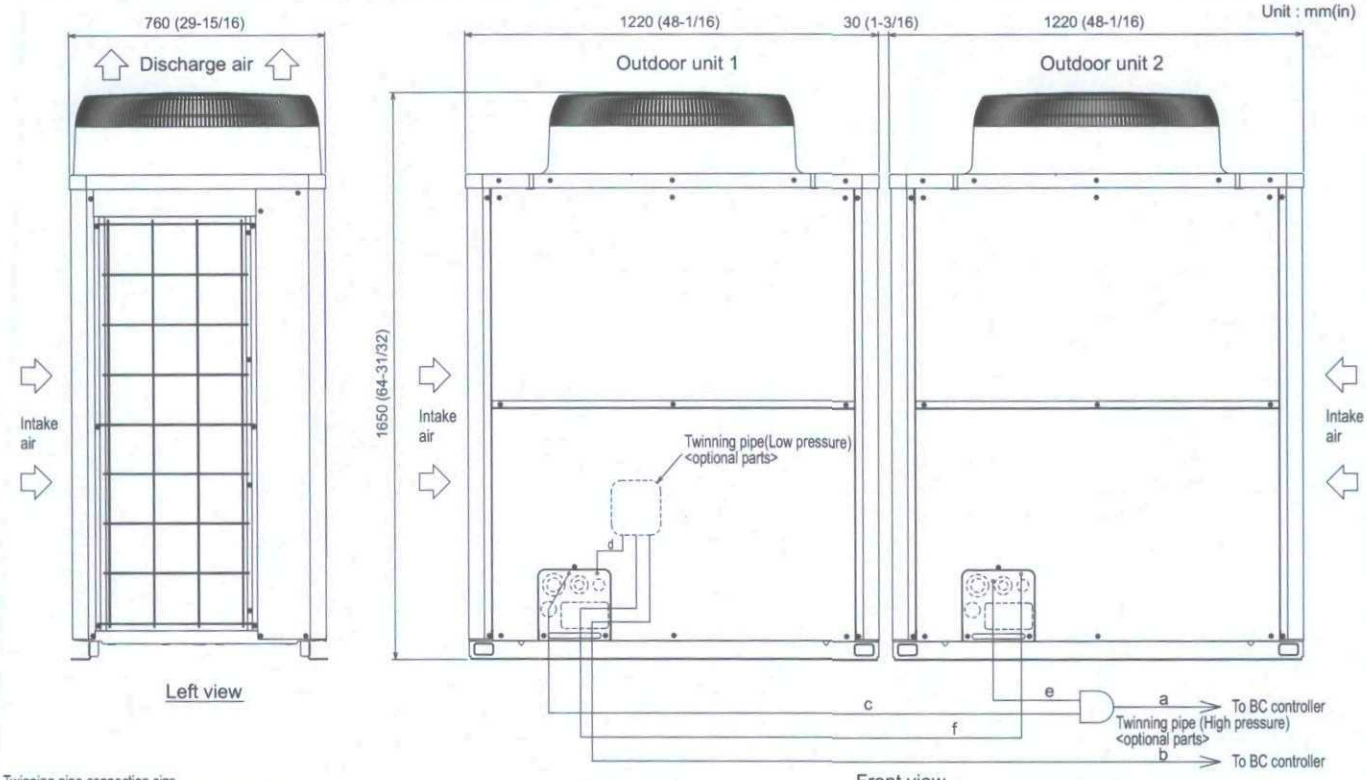
* Twinning Kit is necessary to combine the refrigerant flows of the modules and is included in the outdoor unit set.

Specifications		System	Module 1	Module 2
Unit Type		PURY-P240TSHMU-A	PURY-P120THMU-A	PURY-P120THMU-A
Nominal Cooling Capacity	Btu/h	240,000	120,000	120,000
Nominal Heating Capacity	Btu/h	240,000	120,000	120,000
External Dimensions (H x W x D)	In. / mm	Refer to Module Data	65 x 48-1/16 x 29-15/16 / 1,650 x 1,220 x 760	65 x 48-1/16 x 29-15/16 / 1,650 x 1,220 x 760
Net Weight	Lbs. / kg	1,170 / 530	585 / 265	585 / 265
Electrical Power Requirements	Voltage, Phase, Hertz	Refer to Module Data**	208-230V, 3-phase, 60Hz	
Cooling Power Input	kW	21.61	Refer to System Data	
Heating Power Input	kW	20.92		
Cooling Current (208/230V)	A	66.6 / 60.2	Refer to System Data	
Heating Current (208/230V)	A	64.5 / 58.3		
Minimum Circuit Ampacity (MCA)**	A	Refer to Module Data**	43 / 40**	43 / 40**
Maximum Overcurrent Protection (MOCP)**	A	Refer to Module Data**	50 / 50**	50 / 50*
Piping Diameter			Refer to System Data	
From Twinning Kit to Indoor Units (Brazed) (In. / mm)	Liquid (High Pressure)	1-1/8 / 28.58		
	Gas (Low Pressure)	1-1/8 / 28.58		
From Modules to Twinning Kit (Brazed) (In. / mm)	Liquid (High Pressure)	Refer to Module Data	3/4 / 19.05	3/4 / 19.05
	Gas (Low Pressure)		1-1/8 / 28.58	1-1/8 / 28.58
Indoor Unit	Total Capacity	50 to 150% of ODUs	Refer to System Data	
	Model / Quantity	P06 ~ P96 / 2 to 50 Max. No. Connectable Branches: 48		
Sound Pressure Levels	dB(A)	63.0	60.0	60.0
Fan		Refer to Module Data		
Type x Quantity			Propeller Fan x 1	Propeller Fan x 1
Airflow Rate	CFM		7,950	7,950
Direct-drive Inverter Motor Output	kW		0.92	0.92
Compressor Operating Range		9% to 100%	Refer to System Data	
Compressor Type x Quantity		Refer to Module Data	Inverter-driven Scroll Hermetic x 1	Inverter-driven Scroll Hermetic x 1
Compressor Motor Output	kW		8.1	8.1
Compressor Crankcase Heater	kW		0.057	0.057
Refrigerant		Refer to Module Data	R410A	
Lubricant			MEL32	
High-pressure Protection Device		Refer to Module Data	601 psi / 4.15 MPa	601 psi / 4.15 MPa
Compressor / Fan Protection Device			Overheat Protection / Thermal Switch	Overheat Protection / Thermal Switch
Inverter Protection Device			Overheat / Overcurrent Protection	Overheat / Overcurrent Protection
Blue Fin Anti-corrosion Protection: Cellulose- and polyurethane-resin coating treatment applied to condenser coil that protects it from air contaminants; ≥1µm thick; Salt Spray Test Method - no unusual rust development to 480 hours.				

** Each individual module requires a separate electrical connection. Reference electrical data for each individual module.

Outdoor Unit: PURY-P240TSHMU-A – DIMENSIONS

Unit : mm(in)



Twinning pipe connection size

Package unit name			PURY-P192TSHMU-A(-BS)	PURY-P216TSHMU-A(-BS)	PURY-P240TSHMU-A(-BS)
Component unit name	Outdoor unit 1		PURY-P96THMU-A(-BS)	PURY-P120THMU-A(-BS)	PURY-P120THMU-A(-BS)
	Outdoor unit 2		PURY-P96THMU-A(-BS)	PURY-P96THMU-A(-BS)	PURY-P120THMU-A(-BS)
Outdoor Twinning Kit(optional parts)			CMY-R100VBK		
BC controller ~ Twinning pipe	High pressure	a	ø22.2(7/8)	ø28.58(1-1/8)	
	Low pressure	b	ø28.58(1-1/8)		

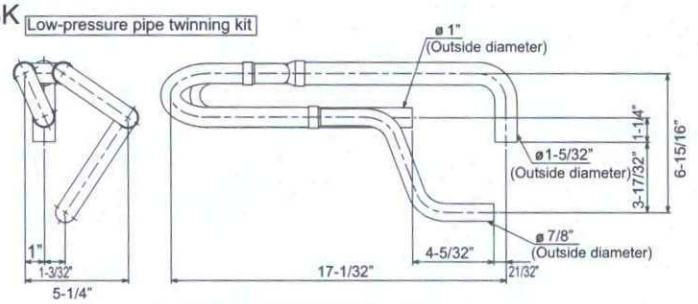
	Unit model	High pressure	Low pressure
		c or e	d or f
Twinning pipe ~ Outdoor unit	P96	ø19.05(3/4)	ø22.2(7/8)
	P120	ø19.05(3/4)	ø28.58(1-1/8)

Note 1.Connect the pipes as shown in the figure above. Refer to the table above for the pipe size.
2.Twinning pipe (high pressure) should not have a side-to-side angle of more than 15 degrees.
3.Refer to the Installation Manual for details of the Twinning pipe installation.
4.The straight length of piping before the Twinning pipe (section "a" in the figure) must be at least 500mm(19-11/16) (*including the straight pipe supplied with the Twinning pipe).
5.Use only the Twinning pipes manufactured by Mitsubishi (optional parts).

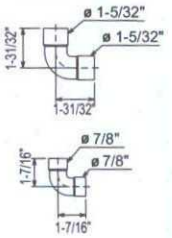
Twinning Kit: CMY-R100VBK

CMY-R100VBK

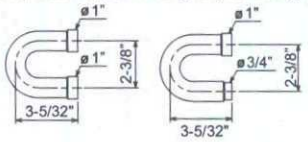
Low-pressure pipe twinning kit



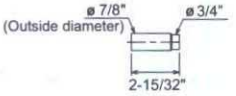
<Elbow pipe (Accessory)>



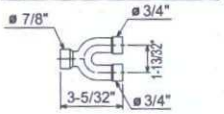
<Low-pressure pipe twinning kit (Accessory)>



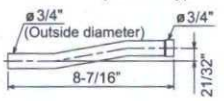
<Reducer pipe(Accessory)>



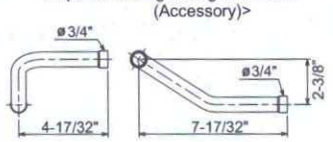
High-pressure twinning pipe

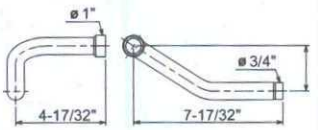


<Pipe for routing through the bottom (Accessory)>

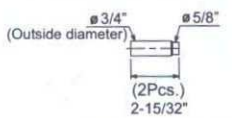


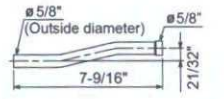
<Pipe for routing through the front (Accessory)>

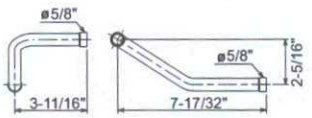


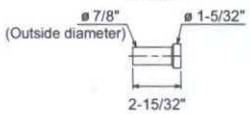


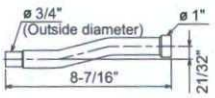
<Reducer pipe(Accessory)>







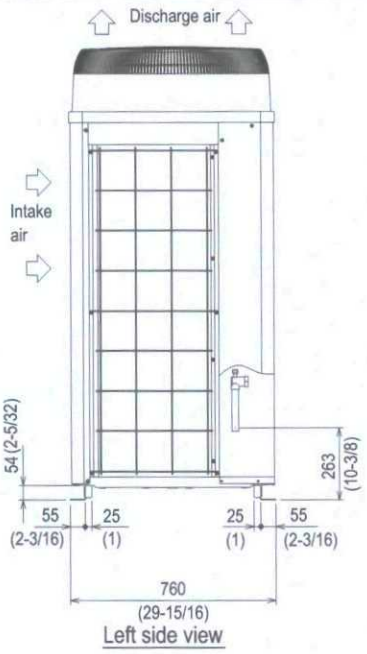




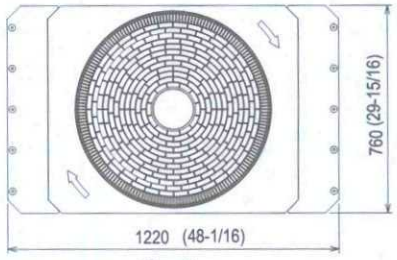
For instructions on piping the units together using the twinning kit, see the Installation Manual.

Modules 1 and 2: PURY-P120THMU-A – DIMENSIONS

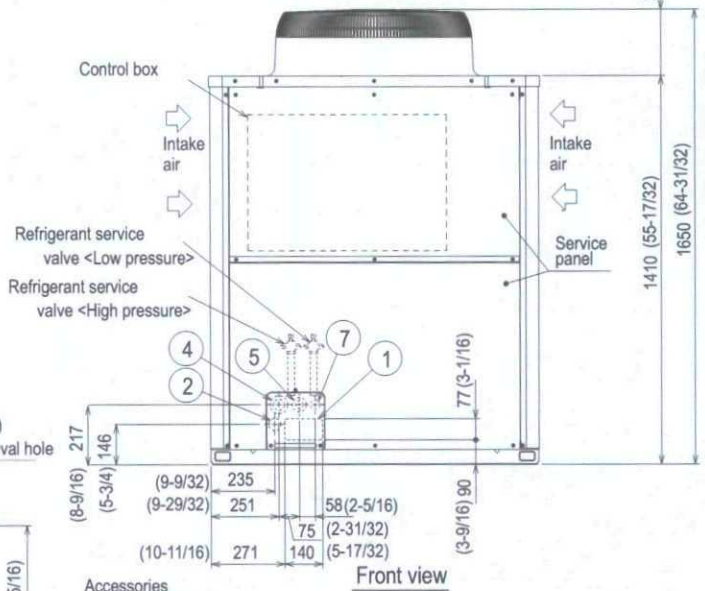
Unit : mm(in)



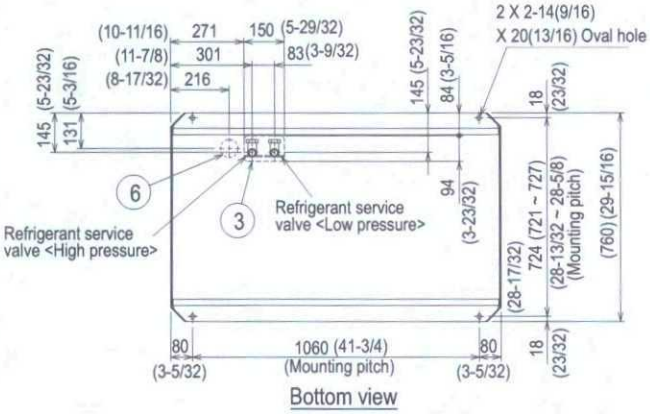
Left side view



Top view



Front view



Bottom view

Accessories

● Connecting pipe

Low pressure	· Pipe	(IDø25.4 [1] X IDø22.2 [7/8])·····P96	1 pc.
	· Pipe	(IDø25.4 [1] X IDø28.58 [1-1/8])·····P120	1 pc.
High pressure	· Pipe	(IDø25.4 [1] X ODø19.05 [3/4])·····P96, P120	1 pc.
	· Elbow	(IDø19.05 [3/4] X ODø19.05 [3/4])·····P96, P120	1 pc.

Note 1. Refer to the Engineering or Installation manual for information regarding necessary clearance around the unit, and installation site requirements.
2. When brazing the pipes, protect the refrigerant service valve by wrapping it with a wet cloth to keep its temperature under 120°C (248°F).

Connecting pipe specifications

	Connection specifications for the refrigerant service valve *1	
Model	High pressure	Low pressure
PURY-P96THMU (-BS)	ø19.05 Brazed (3/4)	ø22.2 Brazed (7/8)
PURY-P120THMU (-BS)		ø28.58 Brazed (1-1/8)

*1. Use only the supplied connecting pipes (for bottom and front piping).

NO.	Usage		Specifications
①	For pipes	Front access hole	140 X 77 Knockout hole (5-17/32)(3-1/16)
②		Front access hole (Use when twinning kit (optional parts) is mounted.)	ø45 Knockout hole (1-25/32)
③		Bottom access hole	150 X 94 Knockout hole (5-29/32)(3-23/32)
④	For wires	Front access hole	ø62.7 or ø34.5 Knockout hole (2-15/32) (1-3/8)
⑤		Front access hole	ø43.7 or ø22.2 Knockout hole (1-3/4) (7/8)
⑥		Bottom access hole	ø65 Knockout hole (2-9/16)
⑦	For transmission cables	Front access hole	ø34 Knockout hole (1-11/32)

Certificate Number FM33568

Mitsubishi Electric Air Conditioning & Refrigeration Systems Works acquired ISO 9001 certification under Series 9000 of the International Standard Organization (ISO) based on a review of quality warranties for the production of refrigeration and air conditioning equipment.

ISO Authorization System
The ISO 9000 series is a plant authorization system relating to quality warranties as stipulated by the ISO. ISO 9001 certifies quality warranties based on the "design, development, production, installation and auxiliary services" for products built at an authorized plant.

Mitsubishi Electric Air Conditioning & Refrigeration Systems Works acquired environmental management system standard ISO 14001 certification.

The ISO 14000 series is a set of standards applying to environmental protection set by the International Standard Organization (ISO).

Certificate Number EC97J1227

MITSUBISHI ELECTRIC

HVAC Advanced Products Division
Mitsubishi Electric & Electronics USA, Inc.

3400 Lawrenceville Suwanee Rd.
Suwanee, GA 30024
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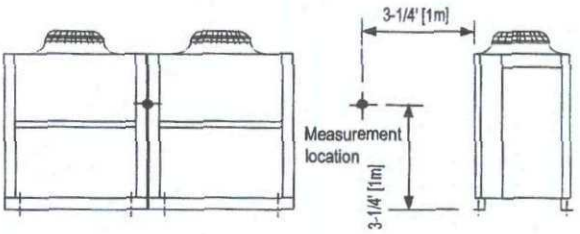
Toll Free: 800-433-4822 (#4)
www.mehvac.com

Specifications are subject to change without notice.

C SD - PURY-P240TSHMU-A - 1 - 200809

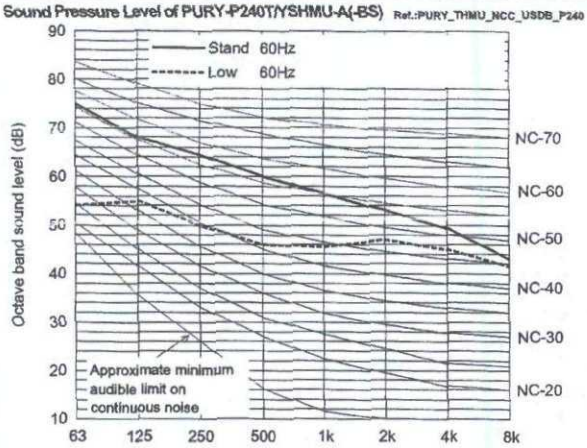
6. SOUND PRESSURE LEVELS

Measurement condition
PURY-P192,216,240TSHMU/YSHMU



Ref.:PURY_THMU_NCC_USDB_R5

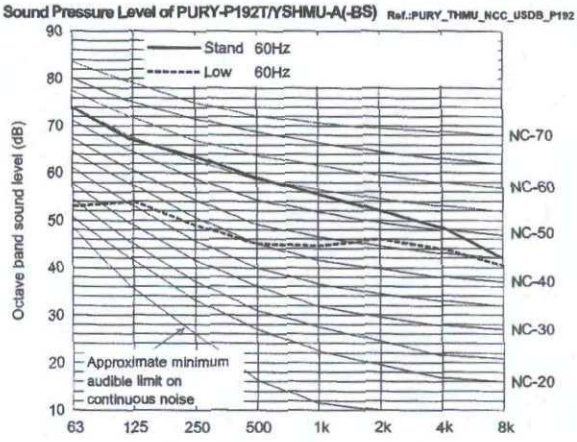
Sound Pressure Level of PURY-P240T/YSHMU-A(-BS) Ref.:PURY_THMU_NCC_USDB_P240



		63	125	250	500	1k	2k	4k	8k	dB(A)
Standard	60Hz	75.0	68.0	64.5	60.0	56.5	53.0	49.5	43.0	63.0
Low noise mode	60Hz	54.0	55.0	50.0	46.0	45.5	47.0	45.0	41.5	53.0

When Low noise mode is set,the A/C system's capacity is limited. The system could return to normal operation from Low noise mode automatically in the case that the operation condition is severe.

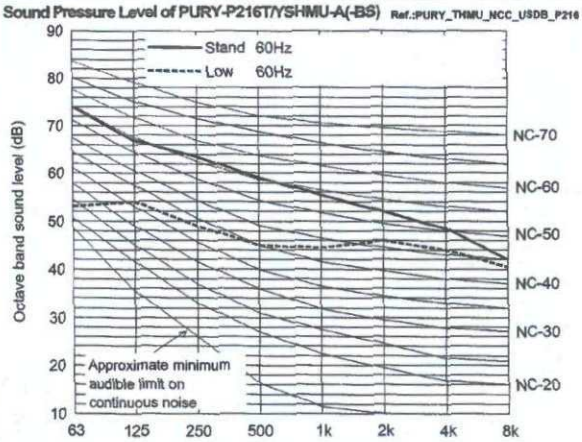
Sound Pressure Level of PURY-P192T/YSHMU-A(-BS) Ref.:PURY_THMU_NCC_USDB_P192



		63	125	250	500	1k	2k	4k	8k	dB(A)
Standard	60Hz	74.0	67.0	63.5	59.0	55.5	52.0	48.5	42.0	62.0
Low noise mode	60Hz	53.0	54.0	49.0	45.0	44.5	46.0	44.0	40.5	52.0

When Low noise mode is set,the A/C system's capacity is limited. The system could return to normal operation from Low noise mode automatically in the case that the operation condition is severe.

Sound Pressure Level of PURY-P216T/YSHMU-A(-BS) Ref.:PURY_THMU_NCC_USDB_P216



		63	125	250	500	1k	2k	4k	8k	dB(A)
Standard	60Hz	74.0	67.0	63.5	59.0	55.5	52.0	48.5	42.0	62.0
Low noise mode	60Hz	53.0	54.0	49.0	45.0	44.5	46.0	44.0	40.5	52.0

When Low noise mode is set,the A/C system's capacity is limited. The system could return to normal operation from Low noise mode automatically in the case that the operation condition is severe.

MITSUBISHI ELECTRIC

Mr. SLIM
Split-ductless A/C and Heat Pumps

SUBMITTAL DATA: MSZ-D36NA & MUZ-D36NA

33,200 BTU/H WALL MOUNTED HEAT PUMP SYSTEM

Job Name: Location: Date:

Purchaser: Engineer:

Submitted to: For ☐ Reference ☐ Approval ☐ Construction

Unit Designation: Schedule No.:

GENERAL FEATURES

- Catechin and anti-allergy enzyme filters for high air-purification capabilites
- Updated sleek, compact indoor unit design
- Remote-controlled wide airflow enables ideal horizontal air distribution
- Self-check function—onboard diagnostics
- Advanced microprocessor control
- Auto restart following a power outage
- Wireless remote controller
- Limited warranty: one year on parts and defects and six years on compressor

OPTIONAL ACCESSORIES

Outdoor Unit

- Drain Socket Assembly (MAC-811DS)

Indoor Unit

- Three-pole Disconnect Switch (TAZ-MS303)
- M-NET Control Adapter (MAC-399IF)
- MA Contact Terminal Interface (MAC-397IF)
- Wired Remote Controller (PAR-21MAA; Requires MAC-3971)
- Centralized On/Off Remote Controller (MAC-821SC; Up to eight units, requires one MAC-397IF per indoor unit)
- Condensate Pump (230V; SI3100-230)
- Anti-allergy Enzyme Filter (Two pieces per set; MAC-1415FT)

Cooling*
Rated Capacity . . . . . 33,200 Btu/h
Minimum Capacity . . . . . 9,800 Btu/h
SEER . . . . . 14.5 Btu/h/W
Total Input . . . . . 4,360 W

Heating at 47° F*
Rated Capacity . . . . . 35,200 Btu/h
Minimum Capacity . . . . . 8,700 Btu/h
HSPF . . . . . 8.2 Btu/h/W
Total Input . . . . . 3,840 W

Heating at 17° F*
Rated Capacity . . . . . 22,800 Btu/h
Total Input . . . . . 3,000 W

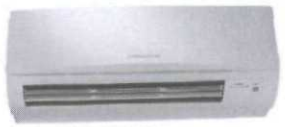
* Rating Conditions (Cooling) - Indoor: 80°F (27°C) DB, 67°F (19°C) WB; Outdoor: 95°F (35°C) DB, 75°F (24°C) WB.
(Heating at 47° F) - Indoor: 70°F (21°C) DB, 60°F (16°C) WB; Outdoor: 47°F (8°C) DB, 43°F (6°C) WB.
(Heating at 17° F) - Indoor: 70°F (21°C) DB, 60°F (16°C) WB; Outdoor: 17°F (-8°C) DB, 15°F (-9°C) WB.

Power Supply . . . . . 208 / 230V, 1-Phase, 60 Hz
Breaker Size . . . . . 25 A

Voltage
Indoor - Outdoor S1-S2 . . . . . AC 208 / 230V
Indoor - Outdoor S2-S3 . . . . . DC 12-24V
Indoor - Remote Controller . . . . . Wireless

OPERATING RANGE

		Indoor Intake Air Temp.	Outdoor Intake Air Temp.
Cooling	Maximum	90°F (32°C) DB, 73°F (23°C) WB	115°F (46°C) DB
	Minimum	67°F (19°C) DB, 57°F (14°C) WB	14°F (-10°C) DB
Heating	Maximum	80°F (27°C) DB, 67°F (19°C) WB	75°F (24°C) DB, 65°F (18°C) WB
	Minimum	70°F (27°C) DB, 60°F (16°C) WB	14°F (-10°C) DB, 13°F (-11°C) WB


Indoor Unit: MSZ-D36NA


Wireless Remote Controller


Outdoor Unit: MUZ-D36NA

Indoor Unit
MCA . . . . . 1 A
Fan Motor . . . . . 0.76 F.L.A.
Airflow
Cooling (Lo - Med - Hi) . . . . . 389 - 639 - 848 Dry CFM
350 - 576 - 763 Wet CFM
Heating (Lo - Med - Hi) . . . . . 445 - 639 - 848 Dry CFM

Sound Pressure Level
Cooling (Lo - Med - Hi) . . . . . 32 - 42 - 49 dB(A)
Heating (Lo - Med - Hi) . . . . . 34 - 42 - 49 dB(A)

DIMENSIONS	UNIT INCHES / MM
W	46-1/16 / 1,170
D	11-5/8 / 295
H	14-3/8 / 365

Weight . . . . . 40 lbs. / 18 kg
Field Drainpipe Size O.D. . . . . 5/8" / 15.88 mm

Outdoor Unit
Compressor . . . . . DC Inverter-driven Rotary
MCA . . . . . 21 A
Fan Motor . . . . . 0.93 F.L.A.
Sound Pressure Level
Cooling . . . . . 56 dB(A)
Heating . . . . . 57 dB(A)

DIMENSIONS	INCHES / MM
W	33-1/16 / 840
D	13 / 330
H	33-7/16 / 849

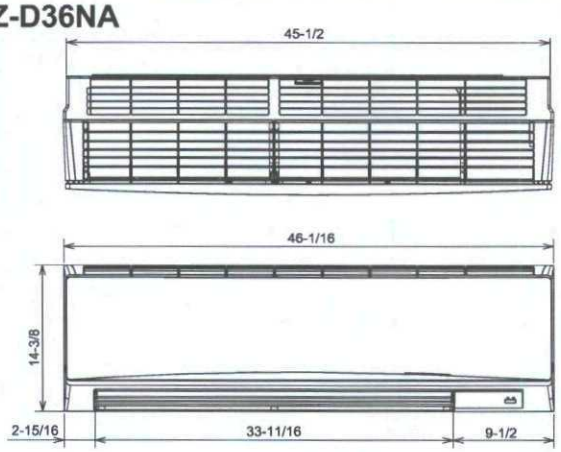
Weight . . . . . 141 lbs. / 64 kg
Refrigerant Type R410A
Refrigerant Pipe Size O.D.
Gas Side . . . . . 5/8" / 15.88 mm
Liquid Side . . . . . 3/8" / 9.53 mm
Max. Refrigerant Pipe Length . . . . . 100' / 30 m
Max. Refrigerant Pipe Height Difference . . . . . 50' / 15 m
Connection Method . . . . . Flared

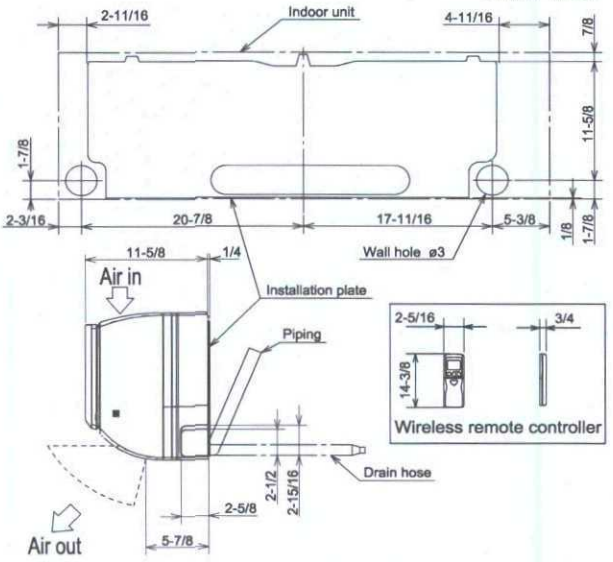
R410A INVERTER

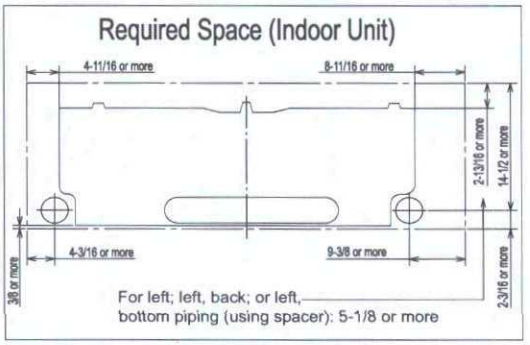
DIMENSIONS: MSZ-D36NA & MUZ-D36NA

MSZ-D36NA

Unit : inch



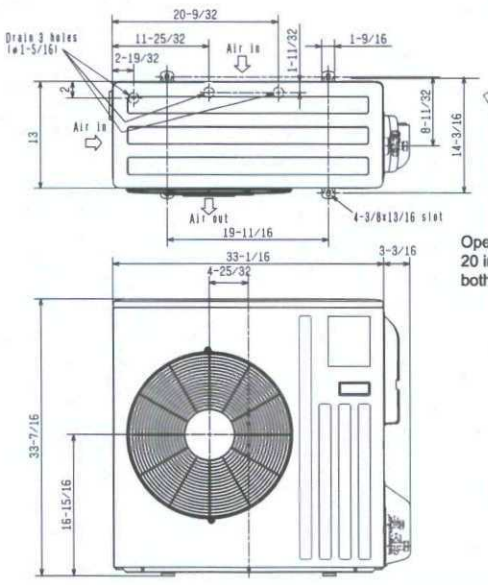


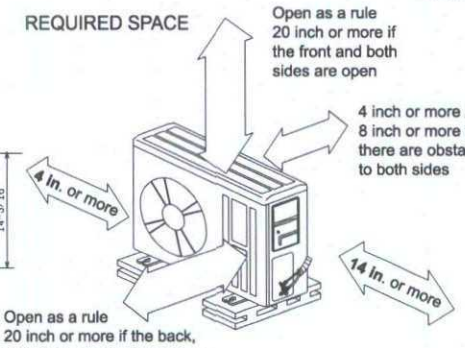


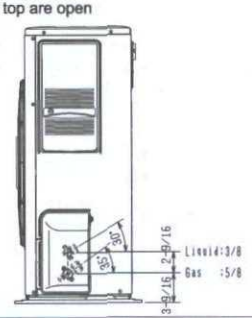
	Piping	Insulation
Liquid line	ø3/8 19-11/16 (Flared connection ø3/8)	ø1-1/4 O.D. ø9/16 I.D.
Gas line	ø5/8 16-7/8 (Joint connection ø5/8)	ø1-15/16 O.D. ø1-1/4 I.D.
Joint	ø5/8 (Flared connection ø5/8)	ø1-15/16 O.D. ø1-1/4 I.D.
Drain hose	Insulation ø1-1/8 Connected part ø9/16 O.D.	

MUZ-D36NA

Unit: inch







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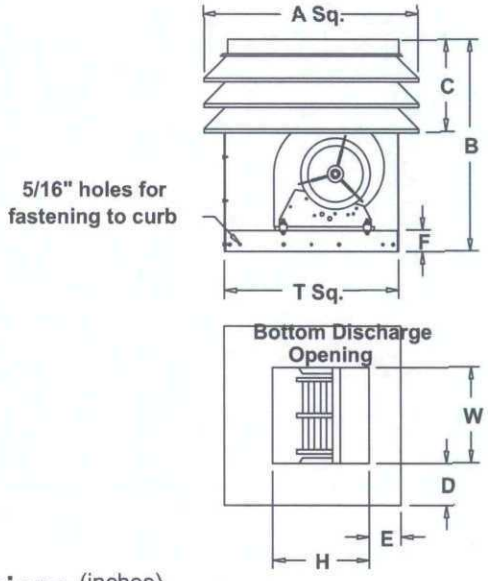
Specifications are subject to change without notice.

COOK

MARK: SF-1,2
PROJECT: LAKESIDE FS
DATE: 07-01-2009

ASP-T

Air Supply Package
Forward Curve
Bottom Discharge
Tiered
Roof Mounted



STANDARD CONSTRUCTION FEATURES:

DWDI blower mounted in a totally enclosed 18 gauge galvanized cabinet - Heavy gauge extruded aluminum intake hood with 1" permanent washable filters - Permanently lubricated ball bearing motor - Adjustable pitch drives through 5 HP - Corrosion resistant fasteners - All fans factory adjusted to specified fan RPM.

Performance (*Bhp includes 9% drive loss)

Qty	Catalog Number	Flow (CFM)	SP (inwc)	Fan RPM	Bhp* (HP)
2	120ASP-T	3000	.500	769	.928

Altitude (ft): 500 Temperature (F): 70

Motor Information

HP	RPM	Volts/Ph/Hz	Enclosure	Mounted
1	1725	460/3/60	TEFC	No

Motor efficiency meets EPACT requirements

Sound Data 8 Octave Bands dB (10^{-12} Watts)

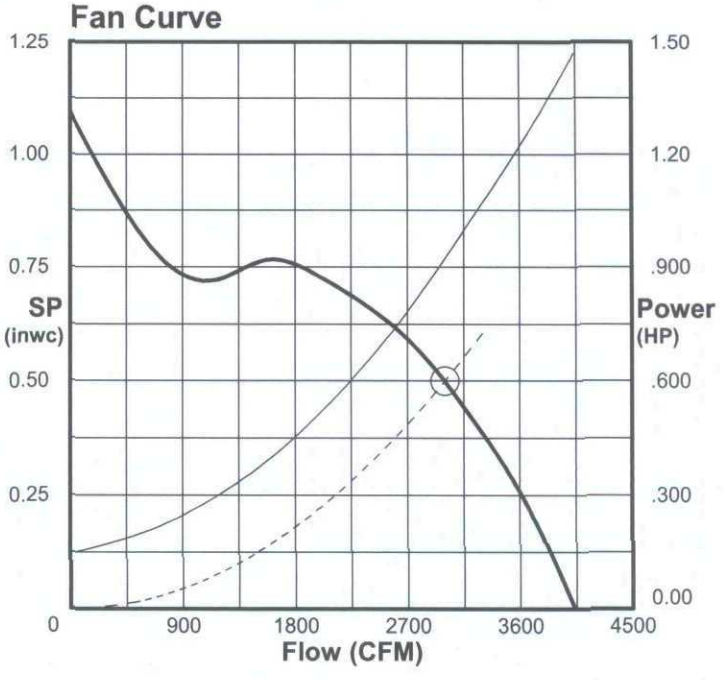
1	2	3	4	5	6	7	8	LwA	dBA	Sones
86	84	76	71	68	64	62	55	75	63	14.2

Dimensions (inches)

A Sq.	38-7/8
B	33-1/2
C	16-3/4
D	8-3/8
E	8-3/4
F	3
T Sq.	32-1/8
Roof Open.	27-1/2
H x W Dischg Open	13-5/16 x 15-3/8
Filters Qty	4
Filters Size	15-1/2 x 26-1/4
No.Tiers	4
Unit Wt(lbs)***	325

***Includes fan, motor & accessories.

Fan Curve



Fan Curve Legend

CFM vs SP	———
CFM vs HP	———
System Curve	- - - -
Point of Operation	◯

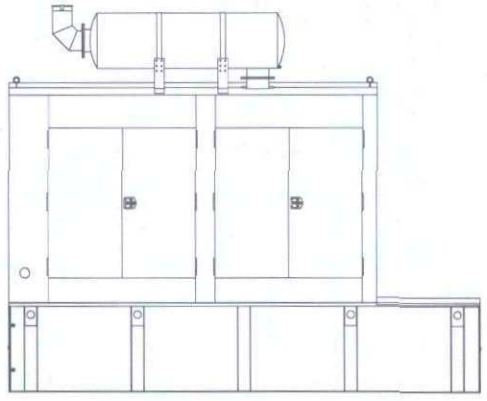
APPENDIX G

Generator Cut Sheets

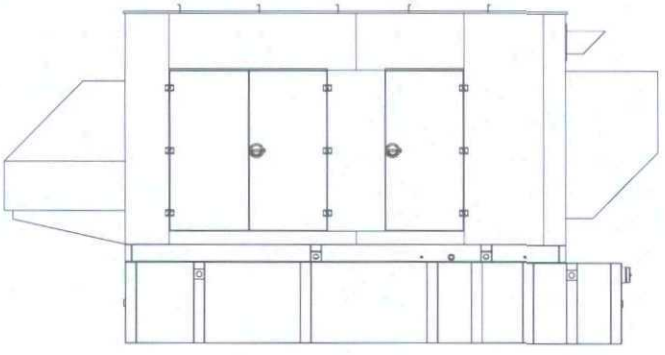
KOHLER POWER SYSTEMS

Weather/Sound Enclosure and Subbase Fuel Tank Packages

ISO 9001 KOHLER POWER SYSTEMS NATIONALLY REGISTERED



Weather Enclosure



Sound Enclosure

Applicable to the following models: 230-450REOZDD

Kohler® enclosures protect stationary generator sets from the elements, animal intrusion, and unwanted entry. The enclosure design allows ample air flow ensuring full generator set performance. The subbase fuel tank provides an onsite diesel fuel supply.

Weather Enclosure Standard Features

- Critical silencer, flexible exhaust connector, and rain cap.
- Lift base or tank mounted, steel (aluminum optional) construction with hinged and removable doors.
- Fade-, scratch-, and corrosion-resistant Kohler® cream beige powder-baked finish.
- Lockable, flush-mounted door latches.
- Air inlet louvers and baffles to reduce rain and snow entry.
- Pitched enclosure roof to minimize water accumulation.
- Battery charger mounting when optional battery charger is ordered.

Sound Enclosure Standard Features

- Includes all of the weather enclosure features with the substitution of a hospital silencer on the level 2 sound enclosure.
- Vertical air inlet and outlet hoods with 90 degree angles to redirect air and reduce noise.
- Acoustic insulation that meets UL94 HF1 flammability classification.
- The sound-attenuated enclosure offers an average of 75 dB(A) sound level at 7 m (23 ft.) using 51 mm (2 in.) of acoustic insulation, acoustic-lined air inlet hoods, and acoustic-lined air discharge hood.

Subbase Fuel Tank Features

- The above-ground rectangular secondary containment tank mounts directly to the generator set, below the generator set skid (subbase).
- Both the inner and outer UL-listed tanks have emergency relief vents.
- Flexible fuel lines are provided with subbase fuel tank selection.
- The containment tank's double-wall construction protects against fuel leaks or ruptures. The inner (primary) tank is sealed inside the outer (secondary) tank. The outer tank contains the fuel if the inner tank leaks or ruptures.

APPENDIX H
U.S. Department of Transportation Construction Equipment Noise Data Tables

9.0 CONSTRUCTION EQUIPMENT NOISE LEVELS AND RANGES

9.1 Equipment Type Inventory and Related Emission Levels

Noise levels generated by individual pieces of construction equipment and specific construction operations form the basis for the prediction of construction-related noise levels. A variety of information exists related to sound emissions related to such equipment and operations. This data transcends the period beginning in the 1970s thru 2006. This information exists for both stationary and mobile sources and for steady, intermittent, and impulse type generators of noise.

9.1.1 Stationary Equipment

Stationary equipment consists of equipment that generates noise from one general area and includes items such as pumps, generators, compressors, etc. These types of equipment operate at a constant noise level under normal operation and are classified as non-impact equipment. Other types of stationary equipment such as pile drivers, jackhammers, pavement breakers, blasting operations, etc., produce variable and sporadic noise levels and often produce impact-type noises. Impact equipment is equipment that generates impulsive noise, where impulsive noise is defined as noise of short duration (generally less than one second), high intensity, abrupt onset, rapid decay, and often rapidly changing spectral composition. For impact equipment, the noise is produced by the impact of a mass on a surface, typically repeating over time.

9.1.2 Mobile Equipment

Mobile equipment such as dozers, scrapers, graders, etc., may operate in a cyclic fashion in which a period of full power is followed by a period of reduced power. Other equipment such as compressors, although generally considered to be stationary when operating, can be readily relocated to another location for the next operation.

9.2 Sources of Information

Construction-related equipment and operation noise level data may be provided by numerous sources, including suppliers, manufacturers, agencies, organizations, etc. Some information is included in this document, and many web-based links are given for equipment manufacturers.

9.3 Specifics of Construction Equipment and Operation Noise Inventories

Details included in each specific inventory of construction equipment and operation noise emission levels are often variable in terms of how data is represented. Some inventories include ranges of noise levels while others present single numbers for each equipment type. Others provide levels for specific models of each type of construction equipment. Often, different noise descriptors are used, such as L_{Aeq}, L_{max}, L_{10}, sound power level, etc. As such, the array of data does not readily lend itself to being combined into a single table or easily compared. As such, this Handbook attempts to summarize a variety of such inventories and provide links to each, thereby providing the reader with a variety of sources from which to choose the appropriate levels for use in his or her respective analysis.

9.4 Summaries of Referenced Inventories

Included below are examples of several inventories of construction-related noise emission values. These and additional inventories are included on the companion CD-ROM.

9.4.1 RCNM Inventory

Equipment and operation noise levels in this inventory are expressed in terms of L_{max} noise levels and are accompanied by a usage factor value. They have been recently updated and are based on extensive measurements taken in conjunction with the Central Artery/Tunnel (CA/T) Project. Table 9.1 summarizes the equipment noise emissions database used by the CA/T Project. While these values represent the "default" values for use in the RCNM, user-defined equipment and corresponding noise levels can be added.

Table 9.1 RCNM Default Noise Emission Reference Levels and Usage Factors.

Equipment Description	Impact Device?	Acoustical Usage Factor (%)	Spec. 721.560 L_{max} @ 50 feet (dBA, slow)	Actual Measured L_{max} @ 50 feet (dBA, slow) (Samples Averaged)	Number of Actual Data Samples (Count)
All Other Equipment > 5 HP	No	50	85	N/A	0
Auger Drill Rig	No	20	85	84	36
Backhoe	No	40	80	78	372
Bar Bender	No	20	80	N/A	0
Blasting	Yes	N/A	94	N/A	0
Boring Jack Power Unit	No	50	80	83	1
Chain Saw	No	20	85	84	46
Clam Shovel (dropping)	Yes	20	93	87	4
Compactor (ground)	No	20	80	83	57
Compressor (air)	No	40	80	78	18
Concrete Batch Plant	No	15	83	N/A	0
Concrete Mixer Truck	No	40	85	79	40
Concrete Pump Truck	No	20	82	81	30
Concrete Saw	No	20	90	90	55
Crane	No	16	85	81	405
Dozer	No	40	85	82	55
Drill Rig Truck	No	20	84	79	22
Drum Mixer	No	50	80	80	1
Dump Truck	No	40	84	76	31
Excavator	No	40	85	81	170
Flat Bed Truck	No	40	84	74	4
Front End Loader	No	40	80	79	96
Generator	No	50	82	81	19
Generator (<25KVA, VMS Signs)	No	50	70	73	74
Gradall	No	40	85	83	70

Grader	No	40	85	N/A	0
Grapple (on backhoe)	No	40	85	87	1
Horizontal Boring Hydraulic Jack	No	25	80	82	6
Hydra Break Ram	Yes	10	90	N/A	0
Impact Pile Driver	Yes	20	95	101	11
Jackhammer	Yes	20	85	89	133
Man Lift	No	20	85	75	23
Mounted Impact Hammer (hoe ram)	Yes	20	90	90	212
Pavement Scarifier	No	20	85	90	2
Paver	No	50	85	77	9
Pickup Truck	No	40	55	75	1
Pneumatic Tools	No	50	85	85	90
Pumps	No	50	77	81	17
Refrigerator Unit	No	100	82	73	3
Rivit Buster/Chipping Gun	Yes	20	85	79	19
Rock Drill	No	20	85	81	3
Roller	No	20	85	80	16
Sand Blasting (single nozzle)	No	20	85	96	9
Scraper	No	40	85	84	12
Sheers (on backhoe)	No	40	85	96	5
Slurry Plant	No	100	78	78	1
Slurry Trenching Machine	No	50	82	80	75
Soil Mix Drill Rig	No	50	80	N/A	0
Tractor	No	40	84	N/A	0
Vacuum Excavator (Vac-Truck)	No	40	85	85	149
Vacuum Street Sweeper	No	10	80	82	19
Ventilation Fan	No	100	85	79	13
Vibrating Hopper	No	50	85	87	1
Vibratory Concrete Mixer	No	20	80	80	1
Vibratory Pile Driver	No	20	95	101	44

Warning Horn	No	5	85	83	12
Welder/Torch	No	40	73	74	5

For each generic type of equipment listed in Table 9.1, the following information is provided:

- an indication as to whether or not the equipment is an impact device;
- the acoustical usage factor to assume for modeling purposes;
- the specification "Spec" limit for each piece of equipment expressed as an L_{max} level in dBA "slow" at a reference distance of 50 foot from the loudest side of the equipment;
- the measured "Actual" emission level at 50 feet for each piece of equipment based on hundreds of emission measurements performed on CA/T work sites; and
- the number of samples that were averaged together to compute the "Actual" emission level.

A comparison of the "Spec" emission limits against the "Actual" emission levels reveals that the Spec limits were set, in general, to realistically obtainable noise levels based on the equipment used by contractors on the CA/T Project. When measured in the field, some equipment such as pile drivers, sand blasting, demolition shears, and pumps tended to exceed their applicable emission limit. As such, these noisy devices needed to have some form of noise mitigation in place in order to comply with the Spec emission limits. Other equipment, such as clamshell shovels, concrete mixer trucks, truck-mounted drill rigs, man-lifts, chipping guns, ventilation fans, pavers, dump trucks, and flatbed trucks, easily complied. Therefore, the Spec emission limits for these devices could have been reduced somewhat further. It is recommended that the user review the RCNM User's Guide contained in Appendix A for detailed guidance regarding application of values contained in Table 9.1.

9.4.2 FHWA Special Report Inventories

Appendix A of the 1977 Handbook provides tables of construction equipment noise levels and ranges. The majority of the data were provided by the American Road Builders Association. These data were taken during a 1973 survey in which member contractors were asked to secure readings of noise exposure to operators of various types of equipment. Additionally, the contractors were asked to take readings at 50 feet from the machinery. These 50-foot peak readings are provided in Tables 9.2 through 9.8. Though the data were produced under varying conditions and degrees of expertise, the values are relatively consistent.

Table 9.2 Construction Equipment Noise Levels Based on Limited Data Samples - Cranes.

Manufacturer	Type or Model	Peak Noise Level (dBA)	Remarks
Northwestern	80D	77	Within 15m 1958 mod
Northwestern	8	84	Within 15m 1940 mod
Northwestern	6	72	Within 15m 1965 mod
American	7260	82	Within 15m 1967 mod
American	599	76	Within 15m 1969 mod
American	5299	70	Within 15m 1972 mod
American	4210	82	Within 15m 1968 mod
Buck Eye	45C	79	Within 15m 1972 mod
Buck Eye	308	74	Within 15m 1968 mod
Buck Eye	30B	73	Within 15m 1965 mod
Buck Eye	30B	70	Within 15m 1959 mod
Link Belt	LS98	76	Within 15m 1956 mod
Manitowoc	4000	94	Within 15m 1956 mod

Grove	RF59	82	Within 15m 1973 mod
Koehr	605	76	Within 15m 1967 mod
Koehr	435	86	Within 15m 1969 mod
Koehr	405	84	Within 15m 1969 mod

Table 9.3 Construction Equipment Noise Levels Based on Limited Data Samples - Backhoes.

Manufacturer	Type or Model	Peak Noise Level (dBA)	Remarks
Link Belt	4000	92	Within 15m 1971 mod
John Deere	609A	85	Within 15m 1971 mod
Case	680C	74	Within 15m 1973 mod
Drott	40 yr.	82	Within 15m 1971 mod
Koehr	1066	81 & 84	Within 15m 2 tested

Table 9.4 Construction Equipment Noise Levels Based on Limited Data Samples - Front Loaders.

Manufacturer	Type or Model	Peak Noise Level (dBA)	Remarks
Caterpillar	980	84	Within 15m 1972 mod
Caterpillar	977K	79	Within 15m 1969 mod
Caterpillar	977	87	Within 15m 1971 mod
Caterpillar	977	94	Within 15m 1967 mod
Caterpillar	966C	84	Within 15m 1973 mod
Caterpillar	966C	85	Within 15m 1972 mod
Caterpillar	966	81	Within 15m 1972 mod
Caterpillar	966	77	Within 15m 1972 mod
Caterpillar	966	85	Within 15m 1966 mod
Caterpillar	955L	90	Within 15m ;1973 mod
Caterpillar	955K	79	Within 15m 1969 mod
Caterpillar	955H	94	Within 15m 1963 mod
Caterpillar	950	78 & 80	Within 15m 1972 mod
Caterpillar	950	75	Within 15m 1968 mod
Caterpillar	950	88	Within 15m 1967 mod
Caterpillar	950	86	Within 15m 1965 mod
Caterpillar	944A	80	Within 15m 1965 mod
Caterpillar	850	82	Within 15m 1968 mod
Michigan	75B	90	Within 15m 1969 mod
Michigan	475A	96	Within 15m 1967 mod
Michigan	275	85	Within 15m 1971 mod

Michigan	125	87	Within 15m 1967 mod
Hough	65	82	Within 15m 1971 mod
Hough	60	91	Within 15m 1961 mod
Hough	400B	94	Within 15m 1961 mod
Hough	H90	86	Within 15m 1961 mod
Trojan	3000	85	Within 15m 1956 mod
Trojan	RT	82	Within 15m 1965 mod
Payloader	H50	85	Within 15m 1963 mod

Table 9.5 Construction Equipment Noise Levels Based on Limited Data Samples - Dozers.

Manufacturer	Type or Model	Peak Noise Level (dBA)	Remarks
Caterpillar	D5	83	Within 15m 1967 mod
Caterpillar	D6	85	Within 15m 1967 mod
Caterpillar	D6	86	Within 15m 1964 mod
Caterpillar	D6	81	Within 15m 1967 mod
Caterpillar	D6B	83	Within 15m 1967 mod
Caterpillar	D6C	82	Within 15m 1962 mod
Caterpillar	D7	85	Within 15m 1956 mod
Caterpillar	D7	86	Within 15m 1969 mod
Caterpillar	D7	84	Within 15m 1969 mod
Caterpillar	D7	78	Within 15m 1970 mod
Caterpillar	D7	78	Within 15m 1972 mod
Caterpillar	D7E	86	Within 15m 1965 mod
Caterpillar	D7E	78	Within 15m 1970 mod
Caterpillar	D7E	84	Within 15m 1973 mod
Caterpillar	D7F	80	Within 15m 1972 mod
Caterpillar	D8	92	Within 15m 1954 mod
Caterpillar	D8	95	Within 15m 1968 mod
Caterpillar	D8	86	Within 15m 1972 mod
Caterpillar	D8H	88	Within 15m 1966 mod
Caterpillar	D8H	82	Within 15m 1972 mod
Caterpillar	D9	85	Within 15m 1972 mod
Caterpillar	D9	94	Within 15m 1972 mod
Caterpillar	D9	90	Within 15m 1963 mod
Caterpillar	D9	87	Within 15m 1965 mod
Caterpillar	D9	90	Within 15m 1965 mod

Caterpillar	D9	88	Within 15m 1968 mod
Caterpillar	D9	92	Within 15m 1972 mod
Caterpillar	*D9G*	*85*	*Within 15m 1965 mod*
Allis Chambers	HD41	93	Within 15m 1970 mod
International	TD15	79	Within 15m 1970 mod
International	TD20	87	Within 15m 1970 mod
International	TD25	90	Within 15m 1972 mod
International	TD8	83	Within 15m 1970 mod
Case	1150	82	Within 15m 1972 mod
John Deer	350B	77	Within 15m 1971 mod
John Deer	450B	65	Within 15m 1972 mod
Terex	8230	70	Within 15m 1972 mod
Terex	8240	93	Within 15m 1969 mod
Michigan	280	85	Within 15m 1961 mod
Michigan	280	90	Within 15m 1962 mod
Caterpillar	824	90	Within 15m 1968 mod

Table 9.6 Construction Equipment Noise Levels Based on Limited Data Samples - Graders.

Manufacturer	Type or Model	Peak Noise Level (dBA)	Remarks
Caterpillar	16	91	Within 15m 1969 mod
Caterpillar	16	86	Within 15m 1968 mod
Caterpillar	140	83	Within 15m 1970 mod
Caterpillar	14E	84	Within 15m 1972 mod
Caterpillar	14E	85	Within 15m 1971 mod
Caterpillar	14C	85	Within 15m 1971 mod
Caterpillar	14B	84	Within 15m 1967 mod
Caterpillar	12F	82	Within 15m 1961-72 mod
Caterpillar	12F	72-92	Within 15m 1961-72 mod
Caterpillar	12E	81.3	Within 15m 1959-67 mod
Caterpillar	12E	80-83	Within 15m 1959-67 mod
Caterpillar	12	84.7	Within 15m 1960-67 mod
Caterpillar	12	82-88	Within 15m 1960-67 mod
Gallon	T500	84	Within 15m 1964 mod
Allis Chambers		87	Within 15m 1964 mod

Table 9.7 Construction Equipment Noise Levels Based on Limited Data Samples - Scrapers.

Manufacturer	Type or Model	Peak Noise Level (dBA)	Remarks
Caterpillar	660	92	Within 15m
Caterpillar	641B	85	Within 15m 1972 mod
Caterpillar	641B	86	Within 15m 1972 mod
Caterpillar	641	80 & 84	Within 15m 1972 mod
Caterpillar	641	83 & 89	Within 15m 1965 mod
Caterpillar	637	87	Within 15m 1971 mod
Caterpillar	633	87	Within 15m 1972 mod
Caterpillar	631C	89	Within 15m 1973 mod
Caterpillar	631C	83	Within 15m 1972 mod
Caterpillar	631B	94	Within 15m 1969 mod
Caterpillar	631B	84-87	Within 15m 1968 mod
Caterpillar		85 avg.	Within 15m 1968 mod
Caterpillar	621	90	Within 15m 1970 mod
Caterpillar	621	86	Within 15m 1967 mod
Caterpillar	613	76	Within 15m 1972 mod
Terex	TS24	87	Within 15m 1972 mod
Terex	TS24	84-91	
Terex	TS24	82	Within 15m 1971 mod
Terex	TS24	81-83	Within 15m 1971 mod
Terex	TS24	94	Within 15m 1966 mod
Terex	TS24	92-98	Within 15m 1966 mod
Terex	TS24	94.7	Within 15m 1963 mod
Terex	TS24	94-95	Within 15m 1963 mod
Terex	TS14	82	Within 15m 1969 mod
Terex	S35E	84	Within 15m 1971 mod

Table 9.8 Noise Levels of Standard Compressors.

Manufacturer	Model	Silenced or Standard	Type Eng.	Type Comp.	Test Avg. Cond. (cfm.psi)	Avg. Cond. Noise Lev. (cfm.psi) (dBA) at 7m*
Atlas	ST-48	Standard	Diesel	Reciprocal	160,100	83.6
Atlas	ST-95	Standard	Diesel	Reciprocal	330,105	80.2
Atlas	VSS-170Dd	Silenced	Diesel	Reciprocal	170,850	70.2
Atlas	VT-85M	Standard	Gas	Reciprocal	85,100	81.4
Atlas	VS-85Dd	Silenced	Gas	Reciprocal	85,100	75.5
Atlas	VSS-125Dd	Silenced	Diesel	Reciprocal	125,100	70.1

Atlas	STS-35Dd	Silenced	Diesel	Reciprocal	125,100	73.5
Atlas	VSS-170Dd	Silenced	Diesel	Reciprocal	170,100	
Gardner-Denver	SPWDA/2	Silenced	Diesel	Rotary-Screw	1200,000	73.3
Gardner-Denver	SPQDA/2	Silenced	Diesel	Rotary-Screw	750,000	78.2
Gardner-Denver	SPHGC	Silenced	Gas	Rotary-Screw	185,000	77.1
Ingersoll-Rand	DXL 1200	Standard	Diesel	Rotary-Screw	1200,125	92.6
Ingersoll-Rand	DXL 1200 (doors open)	Standard	Diesel	Rotary-Screw	1200,125	
Ingersoll-Rand	DXL 900S	Silenced	Diesel	Rotary-Screw	900,125	76.0
Ingersoll-Rand	DXL 900S	Silenced	Diesel	Rotary-Screw	900,125	75.1
Ingersoll-Rand	DXLCU1050	Standard	Diesel	Rotary-Screw	1050,125	90.2
Ingersoll-Rand	DXL 900S	Silenced	Diesel	Rotary-Screw	900,125	75.3
Ingersoll-Rand	DXL 900S	Silenced	Diesel	Rotary-Screw	900,125	75.0
Ingersoll-Rand	DXL 900	Standard	Diesel	Rotary-Screw	900,125	89.9
Ingersoll-Rand	DXL 750	Standard	Diesel	Rotary-Screw	750,125	87.7
Jaeger	A	Standard	Gas	Rotary-Screw	175,100	88.2
Jaeger	A(doors open)	Standard	Gas	Rotary-Screw	175,100	
Jaeger	E	Standard	Gas	Vane	85,100	81.5
Jaeger	E(doors open)	Standard	Gas	Vane	85,100	
Worthington	60 G/2Qt	Silenced	Gas	Vane	160,100	74.2
Worthington	750-QTEX	Silenced	Diesel	Rotary-Screw	750,100	74.7

*Data taken from EPA Report - EPA 550/9-76-004.

9.4.3 FTA Noise and Vibration Assessment Procedure

Chapter 12 of the FTA Transit Noise and Vibration Guidance Handbook discusses construction noise evaluation methodology and contains the noise emission levels for construction equipment displayed in Table 9.9.

Table 9.9 FTA Construction Equipment Noise Emission Levels.

Equipment	Typical Noise Level (dBA) 50 ft from Source*
Air Compressor	81
Backhoe	80
Ballast Equalizer	82
Ballast Tamper	83
Compactor	82
Concrete Mixer	85
Concrete Pump	82
Concrete Vibrator	76
Crane Derrick	88
Crane Mobile	83
Dozer	85
Generator	81
Grader	85
Impact Wrench	85
Jack Hammer	88
Loader	85
Paver	89
Pile Driver (Impact)	101
Pile Driver (Sonic)	96
Pneumatic Tool	85
Pump	76
Rail Saw	90
Rock Drill	98
Roller	74
Saw	76
Scarifier	83
Scraper	89
Shovel	82
Spike Driver	77
Tie Cutter	84
Tie Handler	80
Tie Inserter	85
Truck	88

*Table based on EPA Report, measured data from railroad construction equipment taken during Northeast Corridor improvement project and other measured data.

9.5 Links to Equipment Manufacturers

Table 9.10 contains web-based links to manufacturers of construction equipment. While few of these links contain noise-related data associated with the equipment, they provide descriptions and/or specifications related to the equipment, as well as sources for possibly obtaining additional information related to the equipment. Information in this table is by no means all-inclusive and does not represent any type of endorsement of the manufacturers, suppliers, or equipment. Users are hereby advised that the referenced websites may have certain restrictions, copyrights, etc., associated with any use of data contained therein.

Table 9.10 Equipment Manufacturers and Websites.

Equipment	Manufacturer	Website Address
Arrow Boards		
	North Star	http://northstar-traffic.com/index.cfm?SC=14&PT=1
	Trafcom	http://www.trafcon.com
	Allmand	http://www.allmand.com/MB%20AB%20page.htm
Articulated Trucks		
	Case	http://www.casece.com/products/products.asp?RL=NAE&id=196
	Hitachi	http://www.hitachi-c-m.com/global/products/articulate/index.html
	Terex	http://www.terex.com/main.php
	Caterpillar	http://www.cat.com/cda/layout?m=37840&x=7
	Volvo	http://www.volvo.com/constructionequipment/na/en-us/products/articulatedhaulers/
Asphalt Saws		
	Allied	http://www.alliedcp.com/products/rotocut.asp
Augers - See Drills / Augers		
Backhoes - See Loaders/Backhoes		
Boring Equipment - See Pile Drivers/Boring Equipment		
Compaction Equipment		
	Allied	http://www.alliedcp.com/products/compactor.asp
Compressors		
	Sullair	http://www.sullair.com/corp/details/0,10294,CLI1_DIV61_ETI5714,00.html
	Compair	http://www.compair.com/Products/Portable_Compressors.aspx
Concrete and Asphalt Batch/Mixing Plants and Equipment		
	Con-E-Co	http://www.con-e-co.com/products.cfm
	Terex	http://www.terex.com/main.php
	Gunter & Zimmerman	http://www.guntert.com/concrete_mobilebatching.asp
	Rex Con	http://www.rexcon.com
Concrete Breakers/ Hydraulic Hammers/Hydraulic Breakers		
	Drillman	http://www.drillmanindia.com/concrete-breaker.html
	Hydro Khan	http:/www.sangi.co.kr/english/e_product1_2.php
	Stanley	http://www.stanley-hydraulic-tools.com/Hand%20Held/NoAmbreakers.htm
	Lynx	http://www.stanley-hydraulic-tools.com/Lynx/breakers.htm
Concrete Chain Saws		
	Lynx	http://www.stanley-hydraulic-tools.com/Lynx/concrete-saws.htm
Concrete Core Drilling Machines		
	Multiquip	http://www.multiquip.com/multiquip/318_ENU_HTML.htm
Concrete Cutters		

	Vermeer	http://www.vermeermfg.com/vcom/TrenchingEquipment/Line.jsp?PrdlnID=3618
Concrete/Material Pumps		
	Multiquip	http://www.multiquip.com/multiquip/309_ENU_HTML.htm
	Reed	http://www.reedpumps.com/
Concrete Mixer Trucks		
	Oshkosh	http://www.oshkoshtruck.com/concrete/products~overview~home.cfm
	London	http://www.lmi.ca/mixers.cfm
	Terex/Advance	http://www.advancemixer.com
Concrete Saws		
	Multiquip	http://www.multiquip.com/multiquip/315_ENU_HTML.htm
	Diamond Core Cut	http://www.diamondproducts.com/dp_home.htm
Concrete Screeds		
	Multiquip	http://www.multiquip.com/multiquip/317_ENU_HTML.htm
Concrete Vibrators		
	Multiquip	http://www.multiquip.com/multiquip/313_ENU_HTML.htm
	Sullair	http://www.sullair.com/corp/details/0,10294,CLI1_DIV61_ETI5722,00.html
Cranes		
	Malcolm Drilling	www.malcolmdrilling.com
	Link-Belt	http://www.linkbelt.com/lit/products/frameproducthome.htm
	Casagrande	http://www.casagrandegroup.com
	Liebherr	http://www.liebherr.com/em/en/35381.asp
	Terex	http://www.terex.com/main.php
Crawler Tractors - See Dozers/Crawler Tractors		
Crushing and Screening Equipment		
	Cedarapids	http://www.cedarapids.com/crushscr.htm
	Hitachi	http://www.hitachi-c-m.com/
	Komatsu	http://www.komatsu.com/ce/products/mobile_crushers.html
	Terex	http://www.terex.com/main.php
Crushers/Pulverizers		
	Hydro Khan	http://www.sangi.co.kr/english/e_product3.php
Cutoff Saws		
	Multiquip	http://www.multiquip.com/multiquip/309_ENU_HTML.htm
	Lynx	http://www.stanley-hydraulic-tools.com/Lynx/cutoff%20saw.htm
Dozers/CrawlerTractors		
	John Deere	http://www.deere.com/en_US/cfd/construction/deere_const/crawlers/deere_dozer_sele
	Caterpillar	http://www.cat.com/cda/layout?m=37840&x=7
	Case	http://www.casece.com/products/products.asp?RL=NAE&id=2
	Komatsu	http://www.komatsu.com/ce/products/crawler_dozers.html
Dewatering Pumps		
	Multiquip	http://www.multiquip.com/multiquip/371_ENU_HTML.htm
Drills / Augers		
	Malcolm Drilling	www.malcolmdrilling.com
	Casagrande	www.casagrandegroup.com
	Soilmec	http://www.soilmec.com/_vti_g1_techno.aspx?rpstry=4_

	Terex	http://www.terex.com/main.php
Excavators		
	Hitachi	http://www.hitachi-c-m.com/global/products/excavator/index.html
	Caterpiller	http://www.cat.com/cda/layout?m=37840&x=7
	Volvo	http://www.volvo.com/constructionequipment/na/en-us/products/compactexcavators/
		http://www.volvo.com/constructionequipment/na/en-us/products/wheeledexcavators/
		http://www.volvo.com/constructionequipment/na/en-us/products/crawlerexcavators/
	John Deere	http://www.deere.com/en_US/cfd/construction/deere_const/excavators/deere_excavat
	Liebherr	http://www.liebherr.com/em/en/18891.asp
	Soilmec	http://www.soilmec.com/_vti_g1_t02.aspx?rpstry=29_
	Gehl	http://www.gehl.com
	Case	http://www.casece.com/products/products.asp?RL=NAE&id=216
	Komatsu	http://www.komatsu.com/ce/products/crawler_excavators.html
		http://www.komatsu.com/ce/products/wheel_excavators.html
	Terex	http://www.terex.com/main.php
	Link-Belt	http://www.lbxco.com/lx_series.asp
	Gradall	http://www.gradall.com/
	Badger Daylighting	http://www.badgerinc.com/
Fork Lifts - See Lifts / Variable Reach Fork Lifts/ Material Handlers		
Generators		
	Terex	http://www.terex.com/main.php
	Multiquip	http://www.multiquip.com/multiquip/212_ENU_HTML.htm
	Sullair	http://www.sullair.com/corp/details/0,10294,CLI1_DIV61_ETI5714,00.html
	Baldor	http://www.baldor.com/products/generators/ts.asp
Graders		
	Case	http://www.casece.com/products/products.asp?RL=NAE&id=190
	Volvo	http://www.volvo.com/constructionequipment/na/en-us/products/MotorGraders/
	Komatsu	http://www.komatsu.com/ce/products/motor_graders.html
	Terex	http://www.terex.com/main.php
Hand Compaction Equipment		
	Terex	http://www.terex.com/main.php
	Multiquip	http://www.multiquip.com/multiquip/56_ENU_HTML.htm
Hydraulic Hammers/Hydraulic Breakers - See Concrete Breakers/ HydraulicHammers/Hydraulic Breakers		
Jackhammers - See Rock Drilling Equipment/Jackhammers		
Lifts / Variable Reach Fork Lifts/ Material Handlers		
	Genie Lift	www.genielift.com
	Sky Track	www.kirby-smith.com/
	Ingersol-Rand	www.ingersollrand.com
	Terex	http://www.terex.com/main.php
	Roadtec	http://www.roadtec.com/www/docs/102/mtv-material-transfer-vehicle/
LightTowers		
	Baldor	http://www.baldor.com/products/generators/mlt.asp
	Multiquip	http://www.multiquip.com/multiquip/293_ENU_HTML.htm
	Allmand	http://www.allmand.com/Night%20Lite%20Pro%20page.htm
Loaders/Backhoes		
	Case	http://www.casece.com/products/products.asp?RL=NAE&id=54

	Caterpillar	http://www.cat.com/cda/layout?m=37840&x=7
	Volvo	http://www.volvo.com/constructionequipment/na/en-us/products/backhoeloaders/
	John Deere	http://www.deere.com/en_US/cfd/construction/deere_const/backhoes/deere_backhoe_
	Komatsu	http://www.komatsu.com/ce/products/backhoe_loaders.html
Material Handlers - See Lifts / Variable Reach Fork Lifts/ Material Handlers		
Milling Machines		
	Wirtgen	https://www.wirtgenamerica.com/noflash.html
Mining Trucks - See Rigid Dump Trucks/Mining Trucks		
Pans - See Scrapers/Pans		
Pavers/Paving Equipment		
	Caterpillar/ Barber Greene	http://www.cat.com/cda/layout?m=37840&x=7
	Rosco	http://www.leeboy.com/rosco/
	Bomag	http://www.bomag.com/americas/index.aspx?&Lang=478
	Gehl	http://www.gehl.com/const/prodpg_ap.html
	Leeboy	http://www.leeboy.com/leeboy/
	Terex	http://www.terex.com/main.php
	Ingersoll-Rand	http://www.road-development.irco.com/Default.aspx?MenuItemID=12
	Vogele	http://www.vogeleamerica.com/noflash.html
	GOMACO	http://www.gomaco.com/index.html
	Roadtec	http://www.roadtec.com
Pile Drivers/Boring Equipment		
	Soilmec	http://www.soilmec.com/_vti_g1_t09.aspx?rpstry=29_
	Leffer	http://www.leffer.com/hme.html
	Bauer	http://www.bauer.de/en/maschinenbau/produkte/drehbohrgeraete/bg_reihe/usbg15h.ht
Pipelayers/Trenchers		
	Liebherr	http://www.liebherr.com/em/en/18908.asp
	Caterpillar	http://www.cat.com/cda/layout?m=37840&x=7
	Case	http://www.casece.com/products/products.asp?RL=NAE&id=28&archived=1
	Vermeer	http://www.vermeermfg.com/vcom/TrenchingEquipment/trenching-equipment.htm
	Ditchwitch	http://www.ditchwitch.com/dwcom/Product/ProductView/115
	Eagle	http://www.guntert.com/trenchers_home.asp
Profilers - See Roadway Planers/Profilers		
Rammers		
	Multiquip	http://www.multiquip.com/multiquip/56_ENU_HTML.htm
Rebar Benders/Cutters		
	Multiquip	http://www.multiquip.com/multiquip/1316_ENU_HTML.htm
Recyclers - See Stabilizers/Recyclers		
Rigid Dump Trucks/Mining Trucks		
	Hitachi	http://www.hitachi-c-m.com/global/products/rigid/index.html
	Caterpillar	http://www.cat.com/cda/layout?m=37840&x=7
	Liebherr	http://www.liebherr.com/em/en/18898.asp
	Komatsu	http://www.komatsu.com/ce/products/dump_trucks.html
	Terex	http://www.terex.com/main.php
Roadway Planers/Profilers		
	Terex	http://www.terex.com/main.php
	Roadtec	http://www.roadtec.com/products/cold_planers/default.htm

Rock Drilling Equipment/Jackhammers		
	Drillman	http://www.drillmanindia.com/rock-drilling-machine.html
	Whaker	http://www.wackergroup.com/webapp/wcs/stores/servlet/
	Sullair	http://www.sullair.com/corp/details/0,10294,CLI1_DIV61_ETI5721,00.html
	Allied	http://www.alliedcp.com/products/hammers.asp
Rollers - See Tampers/Rollers		
Scrapers/Pans		
	Terex	http://www.terex.com/main.php
Screening Equipment - See Crushing and Screening Equipment		
Slabbuster		
	Allied	http://www.alliedcp.com/products/slabbuster.asp
Slip Form Pavers		
	Huron	http://www.huronmanufacturing.com/
	Guntert & Zimmerman	http://www.guntert.com/concreteSlipformPavers.asp
Stabilizers/Recyclers		
	Bomag	http://www.bomag.com/americas/index.aspx?&Lang=478
	Komatsu	http://www.komatsu.com/ce/products/mobile_crushers.html
	Terex	http://www.terex.com/main.php
	Wirtgen	https://www.wirtgenamerica.com/noflash.html
	Roadtec	http://www.roadtec.com
Sweepers		
	Elgin	http://www.elginsweeper.com
	Johnston	http://www.johnstonsweepers.com/
Tampers/ Rollers		
	Bomag	http://www.bomag.com/americas/index.aspx?&Lang=478
	Komatsu	http://www.komatsu.com/ce/products/vibratory_rollers.html
	Whaker	http://www.wackergroup.com/webapp/wcs/stores/servlet/
	Lynx	http://www.stanley-hydraulic-tools.com/Lynx/tamper.htm
	Multiquip	http://www.multiquip.com/multiquip/181_ENU_HTML.htm
	Ingersoll-Rand	http://www.road-development.irco.com/Default.aspx?MenuItemID=15
Trenchers - See Pipelayers/Trenchers		
Trucks - See Articulated Trucks, Concrete Mixer Trucks, Rigid Dump Trucks/Mining Trucks		
Vacuum Units		
	Advanced Recycling Systems	www.arsrecycling.com/
	Vacmasters	http://www.vacmasters.com/airsystm.htm
	Vector	http://www.vector-vacuums.com/
Variable Message Signs		
	Allmand	http://www.allmand.com/MB%20only%20page.htm
	North Star	http://northstar-traffic.com/index.cfm?SC=13&PT=1
	Trafcom	http://www.trafcon.com
	Daktronics	http://www.daktronics.com/vms_prod/dak_vms_products.cfm
Vibratory Rammers		
	Whaker	http://www.wackergroup.com/webapp/wcs/stores/servlet/
Welders/Welding Equipment		

	Airgas	www.airgas.com
	Multiquip	http://www.multiquip.com/multiquip/408_ENU_HTML.htm
	Miller	http://www.millerwelds.com/products/
	Lincoln	http://www.mylincolnelectric.com/Catalog/equipmentseries.asp?browse=101|400|
Wheel Loaders		
	Hitachi	http://www.hitachi-c-m.com/global/products/loader/index.html
	Case	http://www.casece.com/products/products.asp?RL=NAE&id=30
	Caterpillar	http://www.cat.com/cda/layout?m=37840&x=7
	Volvo	http://www.volvo.com/constructionequipment/na/en-us/products/wheelloaders/
	Terex	http://www.terex.com/main.php
	Komatsu	http://www.komatsu.com/ce/products/wheel_loaders.html
	TCM	http://www.tcmglobal.net/products/main02.html

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